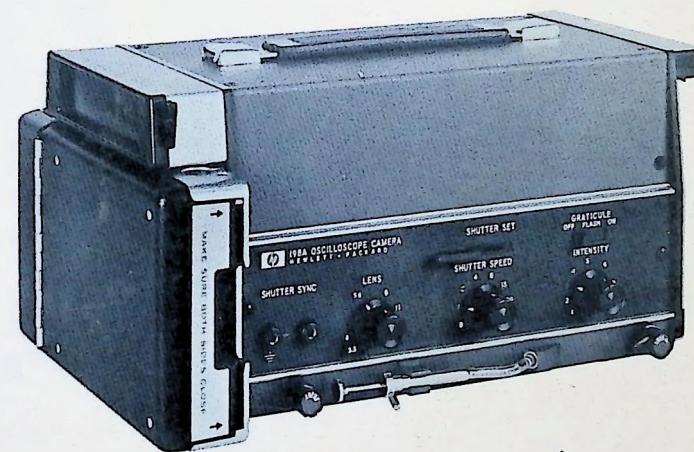


OSCILLOSCOPE CAMERA

198A

SN = 928



HEWLETT  PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.



OPERATING AND SERVICE MANUAL

MODEL 198A

OSCILLOSCOPE CAMERA

SERIALS PREFIXED: 928 -

SEE SECTION VII FOR OTHER SERIALS PREFIXES

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9-1, TAKAKURA-CHO, HACHIOJI-SHI, TOKYO, JAPAN**

TABLE OF CONTENTS

Section	Page	Section	Page
I GENERAL INFORMATION	1-1	V (Cont'd)	
1-1. Scope	1-1	5-11. Print Imperfections	5-1
1-3. Description	1-1	5-13. Performance Check	5-1
1-14. Instrument Identification	1-2	5-15. Shutter Operation	5-1
1-16. Manual Changes	1-2	5-17. Lens Aperture	5-5
II INSTALLATION	2-1	5-19. Shutter Sync	5-5
2-1. Introduction	2-1	5-21. Lamp Operation	5-5
2-3. Inspection	2-1	5-23. Focus	5-5
2-7. Claims	2-1	5-25. Light Infiltration	5-5
2-10. Mounting Instructions	2-1	5-27. Adjustments	5-5
2-12. Dismounting Instructions	2-1	5-29. Control Knob Index Position	
2-14. Storage	2-1	Calibration	5-5
2-16. Environmental Limits	2-2	5-33. Mounting Lock Lever	
2-18. Power Requirements	2-2	Installation	5-6
2-20. Repackaging for Shipment	2-2	5-35. Troubleshooting	5-6
III OPERATION	3-1	5-37. Cleaning and Lubrication	5-6
3-1. Introduction	3-1	5-38. Lens Cleaning	5-6
3-4. Operation Controls and Features .	3-1	5-40. Camera Back Cleaning	5-6
3-20. Film Description	3-3	5-42. Lubrication	5-6
3-22. CRT Phosphor	3-3	5-44. Repair and Replacement	5-6
3-25. Film Loading	3-3	5-46. Control Panel Removal	5-6
3-27. Operation Instructions	3-3	5-47. Control Panel Installation	5-8
3-28. General Considerations	3-3	5-48. Intensity Control (Poten-	
3-33. Focus	3-7	tiometer) Replacement	5-8
3-35. Camera Control Settings	3-7	5-49. Graticule Switch Replacement .	5-8
3-38. Single Sweep Exposure	3-8	5-50. Shutter Set Lever	
3-41. Shutter Synchronization	3-8	Replacement	5-9
3-43. External Graticule		5-51. Microswitch "FLASH"	
Considerations	3-8	Replacement	5-9
3-48. Film Developing	3-8	5-52. Lamp Replacement	5-10
IV PRINCIPLES OF OPERATION	4-1	5-54. Camera Back Replacement	5-10
4-1. Introduction	4-1	5-55. Battery Replacement	5-10
4-3. Camera Back	4-1	VI REPLACEABLE PARTS	6-1
4-5. Development Process	4-1	6-1. Introduction	6-1
4-7. Lens Assembly	4-1	6-3. Ordering Information	6-1
4-9. Shutter Assembly	4-1	VII MANUAL CHANGES AND OPTIONS	7-1/7-2
4-11. Graticule Illumination	4-2	7-1. Manual Changes	7-1/7-2
4-13. Parallax	4-2	7-4. Options	7-1/7-2
4-16. Depth-of-Field	4-3	7-6. Special Instruments	7-1/7-2
4-19. Light Control	4-3	VIII TROUBLESHOOTING	8-1
V MAINTENANCE	5-1	8-1. Introduction	8-1
5-1. Introduction	5-1	8-3. Schematic	8-1
5-3. Print Quality Improvement	5-1	8-5. Component Identification	8-1
5-5. Fogging	5-1	8-7. Troubleshooting	8-1
5-9. Film Tearing	5-1	8-10. Visual Inspection	8-1
		8-12. Mechanical Checkout	8-4
		8-15. Electrical Checkout	8-4

LIST OF ILLUSTRATIONS

Number	Title	Page	Number	Title	Page
1-1.	Model 198A Oscilloscope Camera . . .	1-0	5-1.	Camera Component Locations (Sheet 1 of 3)	5-2
2-1.	Camera Mounting to CRT Oscilloscope .	2-2	5-2.	Roller Assembly Maintenance	5-7
3-1.	Model 198A Controls	3-2	6-1.	Camera Major Parts and Assemblies (Sheet 1 of 3)	6-1
3-2.	Film Loading (Sheet 1 of 3)	3-4	6-2.	Camera Carriage and Lens and Shutter Assemblies (Sheet 1 of 3)	6-5
3-3.	Resulting Conditions When Focusing the Model 198A	3-7	6-3.	Camera Mirror and Lamp Assembly (Sheet 1 of 2)	6-8
3-4.	Film Developing (Sheet 1 of 2)	3-9	6-4.	Camera Base Assembly (Sheet 1 of 3) .	6-10
3-5.	Temperature and Time for Developing	3-11/3-12	6-5.	Camera Control Panel Assembly (Sheet 1 of 2)	6-13
4-1.	Camera Back Operation	4-1	8-1.	Camera Circuit Schematic	8-1
4-2.	Density Exposure Curve	4-2	8-2.	Component Locations (Sheet 1 of 2) . .	8-2
4-3.	Parallax Effects	4-2			

LIST OF TABLES

Number	Title	Page	Number	Title	Page
1-1.	Specifications	1-0	4-1.	Lens Aperature Setting for Corres- ponding Depth-of-Field	4-3
2-1.	Environmental Limits	2-2	5-1.	Camera Lubrication Points	5-8
3-1.	Recommended Camera Settings	3-8	8-1.	Electrical Trouble Analysis (Sheet 1 of 3)	8-4



Figure 1-1. Model 198A Oscilloscope Camera

Table 1-1. Specifications

Film Type: Polaroid® 107 Black and White ASA 3000 8-pack;
Polaroid® 108 Color ASA 75 8-pack. (73 by 96mm)
Type 107 (black and white) development time: 15 seconds.
Type 108 (color) development time: 60 seconds.
Object-to-Image Ratio: 1:0.85
Lens: 75 mm, f/3.5
Shutter
Speeds: B, 1 s, 1/2 s, 1/4 s, 1/8 s, 1/15 s, 1/30 s, 1/60 s. Cable release; cable has thumbscrew lock for time exposures.
Apertures: F/3.5, 4, 5.6, 8, 11, 16, 22.
Focus: Directly adjustable with camera-back closed or open.
Coincidence of vertical light patterns on CRT face indicates correct focus; 15 mm lens movement, relative to camera body and oscilloscope face.
Graticule Illumination: Provided internally. Incandescent lamp and projector/mirror system, with variable intensity control, OFF, FLASH, and ON.
Power Required: 4 ea Type-C, 1.5V dry cells. (graticule illumination)
Synchronization: X-type contacts provided to trigger or synchronize other equipment with shutter release.

Compatibility

Direct: HP 5-inch round and rectangular bezels (140, 180, 1200 series oscilloscopes; 8550 series spectrum analyzers, 780 series monitoring oscilloscopes, 8540, 8410 network analyzers, and all other HP instrumentation having a 5-inch CRT display.

Adapters for other Oscilloscopes:

HP 10356A; Adapts HP 198A camera to Tektronix 560 series rectangular CRTs.
HP 10357A; Adapts HP 198A camera to Tektronix 640 series rectangular CRTs.

Dimensions: 7 9/16" by 12 3/16" by 5 13/16" (192mm by 310mm by 147mm).
Weight: Approximately 6 5/8 lb, (3 kg)
Option 001: 1:0.7 object-to-image ratio, allows entire 5-inch round CRT to be photographed.

"Polaroid"® by Polaroid Corp.

SECTION I

GENERAL

1-1. SCOPE.

1-2. This manual provides operation and service instructions for the Hewlett-Packard Model 198 CRT Oscilloscope Camera (see Figure 1-1) hereinafter referred to as the Model 198A. The instructions give a detailed explanation for mounting the camera on a CRT oscilloscope, operating and servicing the instrument, and ordering replaceable parts. The information in this manual applies directly to the instrument (as manufactured) with the serial prefix as identified on the title page of this manual. If the serial prefix of the instrument does not agree with the serial prefix on the title page, the differences between the instrument and this manual are explained in the MANUAL CHANGES sheet provided with this manual, or in Section VII of this manual. Use the table of contents to locate specific data throughout the manual. Complete camera specifications are listed in Table 1-1.

1-3. DESCRIPTION.

1-4. The Model 198A has been designed and developed to provide maximum ease of use, light weight, and economy. Some of these features are:

- a. Mounts easily, quickly, and directly on the HP round or rectangular display oscilloscopes.
- b. Reduced physical size.
- c. Light weight.
- d. Simplified focusing.
- e. Eliminates little-used camera features.
- f. Provides external controls.
- g. Uses high speed, self-processing polaroid film.
- h. Provides a permanent, accurate, and convenient means of recording oscilloscope displays.

1-5. CONTROL PANEL. The Model 198A has an external panel located on the right-hand side for ease of preselecting settings, and operating the camera. The control panel consists of:

- a. SHUTTER SYNC jacks.
- b. LENS control.
- c. SHUTTER SPEED control.
- d. SHUTTER SET lever.
- e. GRATICULE OFF-FLASH-ON switch.
- f. INTENSITY control.

g. FOCUS control.

h. Mounting clamp LOCK lever.

i. Shutter release.

1-6. FILM AND CAMERA BACK. The Model 198A is designed to use a modified Polaroid Land Camera back. The back is attached to the rear of the camera, and accepts the Polaroid type 107 (black and white) film pack (eight photos), sensitivity ASA 3000, having a developing time of 10 to 15 seconds at a minimum temperature of 60 degrees F. (15 degrees C.) and above. Polaroid type 108 (color) film pack (eight photos) can also be used.

1-7. VIEWER. The Model 198A viewer is located on the rear of the camera, and has a viewer door to permit viewing the CRT screen when focusing the camera, and to prevent the outside light from interfering when photographing. A built-in filter in the viewer decreases outside light from disturbing the observation.

1-8. LENS. The Model 198A is supplied with a 75 mm f/3.5 lens for use in oscilloscope photography. The lens features a flat field of focus, a good edge resolution, and a minimum distortion. Other displayed features are:

- a. Standard between-the-lens shutter and diaphragm with the aperture continuously adjustable from f/3.5 to f/22.
- b. Shutter speeds variable from 1/60 to 1 second.

1-9. SHUTTER. The shutter has a speed switch calibrated in seven time intervals (1/60, 1/30, 1/15, 1/8, 1/4, 1/2 and 1 second). One additional position (B) regulates the shutter for longer time intervals. When in position B, the shutter remains open while the shutter release is pressed and closes when it is released. The shutter release also features a thumb screw which can be tightened when the release is pressed to hold the shutter open for a determined period (T-position) and will allow the shutter to close when loosened.

1-10. SHUTTER SYNC JACKS. The Model 198A is equipped with shutter synchronizing jacks (X-contacts) for use with remote equipment, permitting synchronization of the equipment with the shutter action.

1-11. FOCUSING SYSTEM. The Model 198A Light Curtain focusing system allows rapid in-place focusing without removal of the film or installation of focusing plates. An incandescent lamp is used in the focusing system to provide an even illumination of the phosphor and highlight the black graticule lines.

1-12. POWER SUPPLY. The Model 198A has a built-in power supply consisting of four dry-cell batteries (Size - C, 1.5V). The power supply provides power to the lamp circuit. The life of the batteries will depend on the type and operating conditions.

1-13. MOUNTING CLAMPS. The Model 198A is equipped with upper and lower mounting clamps designed to fit directly on all round and rectangular HP oscilloscope bezels. The clamps will also fit most other commonly used oscilloscopes when fitted with appropriate bezel adapters.

1-14. INSTRUMENT IDENTIFICATION.

1-15. The Model 198A has an eight-digit serial number (000-0000) assigned to the identification plate. When the serial prefix on the title page of this manual coincides with first three digits of the assigned instrument serial prefix, the manual applies directly to the instrument. If the serial prefix is different from that on title page, it indicates a change, and CHANGE SHEETS are supplied with the manual to specify the changes required to update the manual so it will apply directly to the instrument.

1-16. MANUAL CHANGES.

1-17. Manual changes and backdating information are explained in Section VII.

SECTION II

INSTALLATION

2-1. INTRODUCTION .

2-2. This section contains instructions for the Model 198A, from receipt inspection to mounting the camera on a CRT oscilloscope. The instructions also include environmental limits, storage, repackaging and power requirements. The Model 198A has mounting clamps designed to fit all 5-inch HP oscilloscopes having a standard round or rectangular bezel with a depth of 3/4 inch, which permits direct attachment to all HP oscilloscopes. Adapters are available for most oscilloscopes that will not directly accept the Model 198A. Refer to Table 1-1 for appropriate adapters for oscilloscopes other than HP 5-inch oscilloscopes.

2-3. INSPECTION.

2-4. UNPACKAGING. Upon receipt of the Model 198A, open container and carefully remove camera. Retain container and packing material (if reusable) for repackaging and future reshipment.

2-5. VISUAL AND MECHANICAL INSPECTION. Perform a visual and mechanical inspection of the Model 198A checking for mechanical damage. Observe the action of the camera viewer door and shutter (when actuated) and the condition of the lens. If the camera is found to be damaged in any way, notify the carrier immediately. Refer to the warranty on the inside of front cover of this manual.

2-6. OPERATIONAL CHECK. Perform an operational performance check of the Model 198A in accordance with Section V. This performance check will verify if the camera is operating correctly by the quality of prints produced. It also will give a complete check using a method not requiring an oscilloscope. The local Hewlett-Packard Sales/Service Office will give assistance with any problem involving this instrument and its application.

2-7. CLAIMS .

2-8. If physical damage exists, and/or performance of camera does not meet stated specifications at the time the instrument was received, notify the carrier and nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for repair or replacement of instrument without waiting for the carrier to settle claim.

2-9. The warranty for all Hewlett-Packard products can be found on the inside front cover of this manual. Contact the nearest Sales/Service Office for information about warranty claims.

2-10. MOUNTING INSTRUCTIONS.

2-11. The Model 198A is designed for quick mounting on all HP 5-inch round and rectangular oscilloscopes,

and most other commonly used oscilloscopes for which appropriate adapters are available. Mount the Model 198A to applicable oscilloscope in accordance with Figure 2-1 and following steps:

CAUTION

Use the camera carrying handle, do not grip camera by the front open end when handling or carrying. Accidental pressure on the mirror assembly may occur, resulting in misalignment of focusing illumination.

Note

In the event an oscilloscope other than an HP model is to be used, ensure the appropriate bezel adapter (see Table 1-1) has been installed.

- a. Ensure LOCK lever (3) (located below control panel forward) is rotated counterclockwise to horizontal position.
- b. Position camera on oscilloscope bezel, and ensure that upper mounting clamp(1)fingers seat in slot at top of bezel.
- c. Align lower mounting clamp(2) fingers with slot in bottom of bezel.
- d. Rotate LOCK lever (3) to vertical position. Ensure lower clamp fingers (2) engage in bezel slot.

2-12. DISMOUNTING INSTRUCTIONS.

2-13. To dismount the Model 198A from the oscilloscope, proceed in accordance with Figure 2-1 and following steps:

- a. Grip camera handle and rotate LOCK lever (3) counterclockwise to horizontal position.
- b. Tilt bottom of camera slightly away from oscilloscope bezel, and raise camera so upper mounting clamp (1) fingers clear bezel slot. Remove camera.

2-14. STORAGE.

2-15. When storing the Model 198A, particular care must be exercised to protect the instrument from sudden jars or vibrations, rapid changes in temperature, and excessive heat and moisture (see Table 2-1). When the Model 198A is not in use, protect the lens and integral working mechanisms from dust and other foreign matter. If camera is going to be out of use for a long period, remove the batteries to protect camera from damage due to leakage of electrolyte.

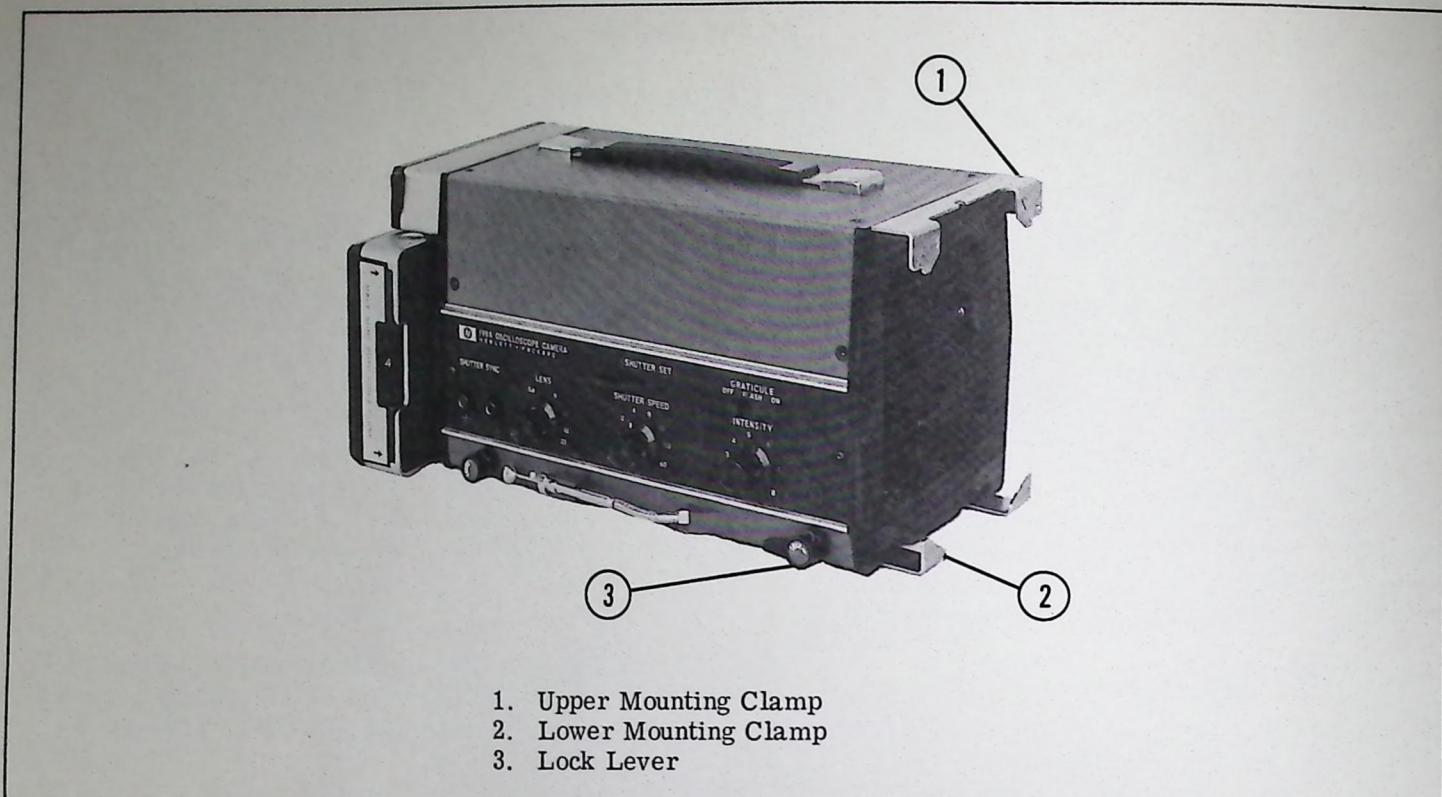


Figure 2-1. Camera Mounting to CRT Oscilloscope

2-16. ENVIRONMENTAL LIMITS.

2-17. The environmental limits listed in Table 2-1 apply to the Model 198A. These limits should not be exceeded.

2-18. POWER REQUIREMENTS.

Table 2-1. Environmental Limits

ENVIRONMENTAL CONDITIONS	WITH FILM	WITHOUT FILM
Maximum storage temperature	70°C*	75°C
Minimum storage temperature	-30°C	-40°C
Maximum operating temperature	50°C	55°C
Minimum operating temperature	-5°C	-20°C
Maximum relative humidity -5°C to 50°C Over 50°C 25°C to 40°C	90% 50% 95%	
Altitude: Operating to	25,000 ft.	

*For a period not to exceed 8 hours.

2-19. The Model 198A has a built-in power supply consisting of four dry cell batteries (Size - C, 1.5 volts) in series. The power supply provides power to the lamp circuit. The life of the batteries will depend on type of batteries and of operating conditions. If the camera is in continuous use, brightness of lamp will decrease to one half in approximately ten hours. Brightness will also decrease to one half after 10,000 operations of the FLASH. For replacement of batteries refer to Section V.

2-20. REPACKAGING FOR SHIPMENT.

2-21. To repack the Model 198A for reshipment, obtain the original shipping container and packing material (if not discarded). If a new container is required, it can be obtained through the local Hewlett-Packard Sales/Service Office, or from HP Customer Service Center. Use the following general packaging instructions for protection of the instrument.

a. Use the original packing material. However, if this is not available, wrap the Model 198A in heavy paper or plastic. Protect the open front end with heavy cardboard (cut to fit between upper and lower clamps). Use ample packing material around instrument.

b. Pack instrument in original container (if available). If original container is not available, pack in heavyweight cardboard shipping container or wooden box.

c. Seal container with heavy tape or metal straps.

d. Mark container as follows:

"FRAGILE - DELICATE INSTRUMENT"

e. Insure the shipment.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains instructions on operating the Model 198A and a brief discussion of considerations when operating controls.

3-3. The purpose of photographing a display on an oscilloscope phosphor is not only to record the display, but to further expand the measurement capability of the oscilloscope itself (i. e.):

- a. To stop a moving display at a given time.
- b. To observe a complete waveform displayed at a low sweep speed.
- c. To observe single-shot displays that do not occur repetitively.
- d. To capture and display high speed signals through the use of ultra-sensitive film.
- e. To make a more accurate quantitative measurement of deflection values.
- f. To make a comparison among various displays.

3-4. OPERATION CONTROLS AND FEATURES.

3-5. The following paragraphs briefly describe the Model 198A controls and how their functions affect operation of the camera. The controls and components shown in Figure 3-1 are indexed for ease of locating.

3-6. VIEWER. The viewer (1) is provided to allow operator direct viewing of CRT screen when focusing the camera. A viewing door and green filter are also provided to shut out the outside light when photographing. The viewing door has an actuating lever (2) on each side of the camera. The lever opens the door to permit direct viewing of the CRT screen. Close the viewer door when photographing if ambient light is bright.

3-7. SHUTTER SYNC. The SHUTTER SYNC (3) is comprised of two jacks that are interconnected to the shutter switch. The switch closes when the shutter is actuated, making ground contact (the timing is X-synchronized contact). Utilizing these jacks, remote equipment can be synchronized with the shutter action.

3-8. LENS CONTROL. The LENS control (4) regulates the aperture of the lens. This adjustment varies the opening of the lens, which regulates the intensity of light transmitted to the film. The adjustment is continuously variable from f/3.5 to f/22 (largest to smallest aperture, respectively). The larger the aperture, the shorter the required exposure time.

3-9. SHUTTER SET LEVER. The SHUTTER SET lever (5) cocks the shutter in ready position when moved fully forward. When the shutter release is pressed, the shutter actuates a full cycle (open then close).

3-10. SHUTTER SPEED CONTROL. The SHUTTER SPEED control (6), regulates the shutter speed switch for length of time that shutter remains open. The control has seven calibrated time intervals - 1, 2, 4, 8, 15, 30, 60 (1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60 seconds). The B(Bulb) position is for required longer periods of shutter opening. When in position, the shutter is actuated open when the release is pressed and closes when released. This position is used when an exposure period of longer than one second is required.

3-11. GRATICULE SWITCH. The GRATICULE switch (7) has three positions, OFF-FLASH-ON. Their functions are as follows:

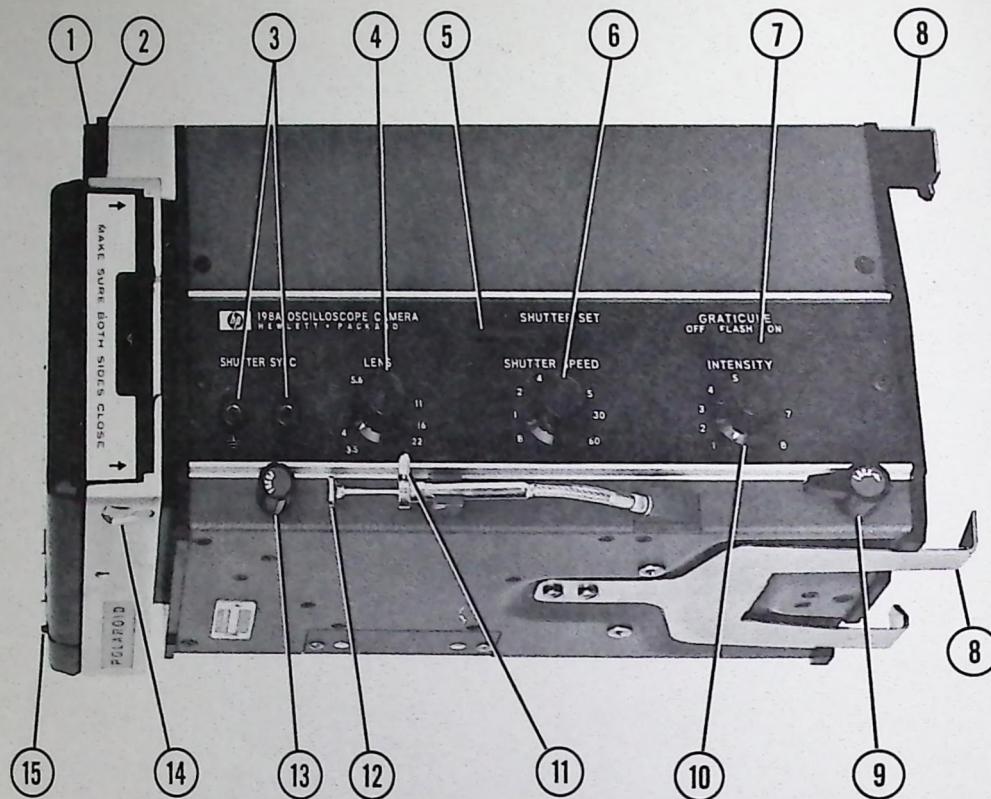
- a. When in the OFF position, there is no power applied to the lamp.
- b. When in FLASH position, power is applied to the lamp only when the shutter release is actuated. The shutter release is interconnected with the FLASH switch so that the switch operates before the shutter. This enables the lamp to rise to full brightness prior to the shutter opening.
- c. In the ON position, power is continuously applied to the lamp. The ON position is most generally used when focusing the camera, or when using the SHUTTER SPEED "B" position.

3-12. MOUNTING BRACKETS. The mounting brackets (8) secure the camera to the oscilloscope bezel when mounted. The fingers on both brackets fit into the slots at top and bottom of the bezel.

3-13. LOCK LEVER. The LOCK lever (9) actuates the lower mounting bracket (up or down) to the locked or unlocked position.

3-14. INTENSITY ADJUSTMENT. The INTENSITY control (10) is a 20K-ohm variable resistor, used to vary the intensity of the lamp illumination during focusing and photographing.

3-15. SHUTTER RELEASE. The shutter release (12) actuates the shutter when pressed, and completes a full cycle (open and close). However, when the SHUTTER SPEED control is set to position B, the shutter will not complete a full cycle when release is pressed. In this position, the shutter opens when the shutter release is pressed, and closes when released.



1. Viewer. Permits direct viewing of CRT screen when focusing camera.
2. Viewer Door Actuating Lever. Opens door to permit viewing. (Close door before exposing film.)
3. SHUTTER SYNC jacks. Synchronizes remote equipment with shutter.
4. LENS control. Adjusts aperture from f/3.5 to f/22.
5. SHUTTER SET lever. Cocks shutter for photographing.
6. SHUTTER SPEED control. Regulates shutter speeds from 1/60 to 1 second.
7. GRATICULE OFF-FLASH-ON switch. Energizes lamp. (Position to OFF when not in use.)
8. Upper and Lower Mounting Clamps. Secures camera to oscilloscope.
9. LOCK lever. Locks mounting clamps to oscilloscope bezel.
10. INTENSITY control. Controls intensity of lamp illumination.
11. Shutter Release Thumb Screw. Holds shutter open when release is pressed.
12. Shutter Release. Actuates shutter.
13. FOCUS control. Adjusts camera focus.
14. Camera Back, Door Latch. Holds door in closed position.
15. Camera Back. Retains film pack.

Figure 3-1. Model 198A Controls and Components

3-16. SHUTTER RELEASE THUMB SCREW. The shutter release thumb screw (11) is located in the shutter release cable housing. It is used to lock the shutter release when longer periods of exposures are required (with SHUTTER SPEED control set to position B). The shutter remains open until the thumb screw is loosened which allows the shutter release to return to normal position, permitting the shutter to close.

3-17. FOCUS CONTROL. The FOCUS control (13) adjusts the camera focus by varying the distance of the internal camera carriage assembly (maximum travel 15 mm) from the CRT. Focusing exactly on the CRT display is possible.

3-18. CAMERA BACK DOOR LATCH. The door latch (14) retains door in the closed position, and when moved to the left, unlatches the door (to open).

3-19. CAMERA BACK. The camera back (15) is a standard Polaroid Land Camera back, and retains the film pack. It is easily accessible for quick film loading.

3-20. FILM DESCRIPTION.

3-21. The film used in the Model 198A is Polaroid type 107, black and white, which contains eight 3-1/4 x 4-1/4 inch exposures. The ASA exposure index for the film is 3000, which makes the film particularly suitable for recording fast transients, as well as all repetitive traces. Film exposures are developed within 10 to 15 seconds at temperatures of 60° F. (15° C.) and above. With temperatures below 60° F. (15° C.), a longer-than-normal development time is required. The time and temperature are very important to obtain good prints, no harm is done if exposure is overdeveloped for a few seconds. However, if exposure is developed for less than recommended time, it will have a gray washed-out look. A print coater, supplied with each film pack, is used after development for permanence of print. The negatives and empty film pack are discarded after use. Extra copies and enlargements of prints may be obtained through the Polaroid Copy Service (refer to instruction sheet supplied with film pack).

WARNING

The Polaroid process uses a caustic jelly which is safely packed inside sealed foil containers within the film pack. If the jelly should accidentally come in contact with the skin, wipe it off immediately and wash exposed area with water to avoid alkali burn. It is particularly important to keep the jelly away from eyes and mouth. Prevent discarded materials from coming in contact with clothing because these materials still contain some jelly.

3-22. CRT PHOSPHOR.

3-23. With all commonly used phosphors, an excellent photograph can usually be obtained. However, the photographic efficiency of a given phosphor can be

important when fast single, or low repetition sweeps are to be recorded. Type P11 phosphor has the most suitable light output (i.e., highest photographic efficiency) for photographic purposes, and should be used when maximum writing speed is desired. Other phosphors, in descending order of efficiency are: P31, P2, P7, and P1.

3-24. Generally, a filter over the CRT face detracts from the quality of picture obtained, increases required exposure, and will increase parallax distortion on external graticule oscilloscopes. Therefore, it is recommended that any filter be removed before taking photographs. However, a blue filter is sometimes used during time exposure photographs to eliminate unwanted cathode glow from non-aluminized CRTs.

3-25. FILM LOADING.

3-26. Film loading can be accomplished when camera is mounted on oscilloscope or unmounted. Film loading may be accomplished in accordance with Figure 3-2.

3-27. OPERATION INSTRUCTIONS.

3-28. GENERAL CONSIDERATIONS.

3-29. The procedure required to photograph an oscilloscope display is subject to a number of variables which include: trace intensity, phosphor type, shutter accuracy, filters used, graticule illumination, sweep duty cycle and speed, and limitations imposed by depth-of-field. A few trial exposures may be necessary when first operating the camera, or when the operating conditions have changed. The following procedures assume the use of an internal graticule oscilloscope with the Model 198A. Special considerations required for external graticule oscilloscopes are explained in Paragraph 3-43.

3-30. CRT FILTERS. Any filter over the CRT face should be removed before operating the camera, except for special purposes discussed in Paragraph 3-24.

3-31. CRT CONTROLS. Trace intensity, in general, should be set so that good trace detail is obtained, and no halo appears around the trace or spot. In special cases, compromises may be necessary to intensify fast-rise or fall portions of a waveform, or to match trace or graticule intensities. Focus and astigmatism should be adjusted for a sharp trace over the full display area; this should be accomplished with a test signal prior to recording single-shot transients.

3-32. SHUTTER SPEED LIMITATIONS. The shutter must remain open long enough to record at least one complete sweep, and preferably five to ten sweeps if no drift or jitter is present. This should be remembered when very slow sweep speeds, or low duty cycle sweeps are being photographed. When the display contains drift or jitter, the shutter speed should be fast enough that only a few sweeps are recorded. It should be noted that time scales on sampling oscilloscopes are not equivalent to sweep speeds on conventional oscilloscopes; since scanning rate is not a calibrated function, special care should be taken so at least five scans are recorded.

1. Open film package as follows:

a. Open top of box and remove coater and instruction sheet (please read it). Pull out film package. Handle it gently and carefully. Save the box to carry prints in safely. It can also be useful when coating prints.

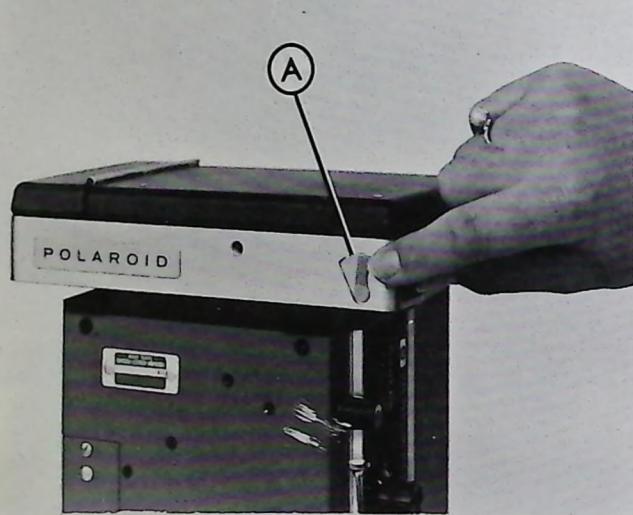
b. Hold package near the edges. DO NOT PRESS HARD ON MIDDLE OF THE PACKAGE. Starting at corner, tear open entire side of package along the dotted line.

c. When the side is open, rip apart front and back of the package. Lift out the film pack. Handle pack by the edges only.

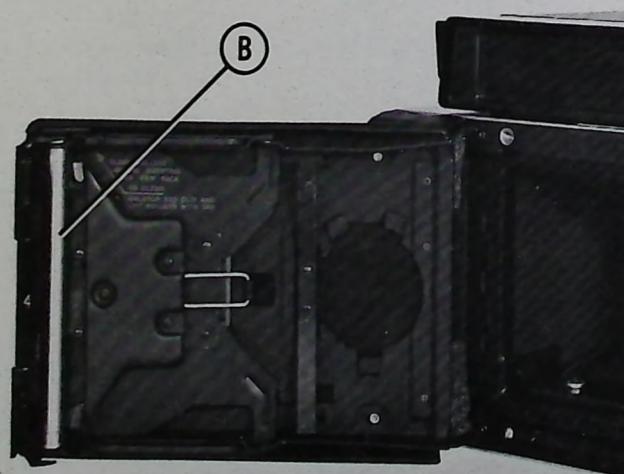
Note

Always open the package and load film pack in the shade, not in direct sunlight, to avoid fogging the film.

2. Load film pack in camera as follows:



a. Push back door latch (A) to the left. Door will open slightly. Then swing door all the way open.



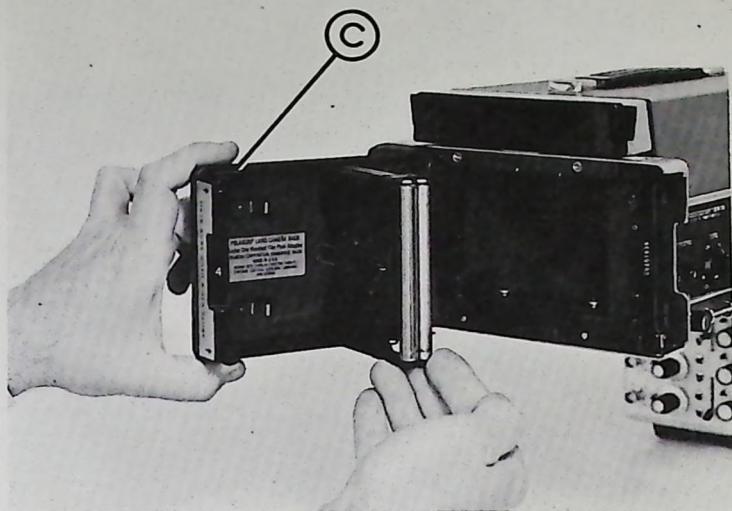
b. Before loading camera, examine the two steel rollers (B). It is important to keep these rollers clean.

Figure 3-2. Film Loading (Sheet 1 of 3).

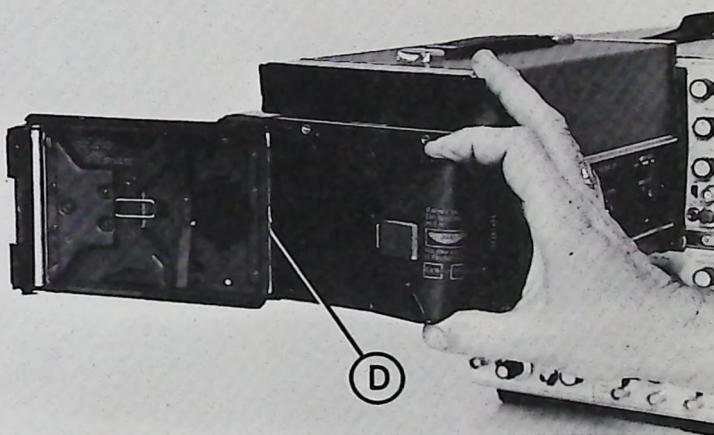
c. For easy access to the rollers, push out the red latch (C), and swing up the roller assembly as shown.

Use a damp cloth to remove any specks or deposits on the rollers. Obstinate particles of dried chemicals can be removed with a matchstick or a small piece of stiff card, but never with a metallic object or a fingernail. Rotate the rollers to inspect and clean them.

After cleaning, push the roller assembly back into position until it locks firmly in place.



d. Hold the film pack so that the safety cover (bearing the words SAFETY COVER THIS SIDE FACES LENS) faces into the film holder. Push the closed end of the pack under the door hinge (D), against spring tension, until it comes to a stop.



e. Push the pack into the holder. It will snap into place.



f. Make sure all the white tabs are free, as shown, and are not trapped between the pack and the film holder.

Figure 3-2. Film Loading (Sheet 2 of 3)

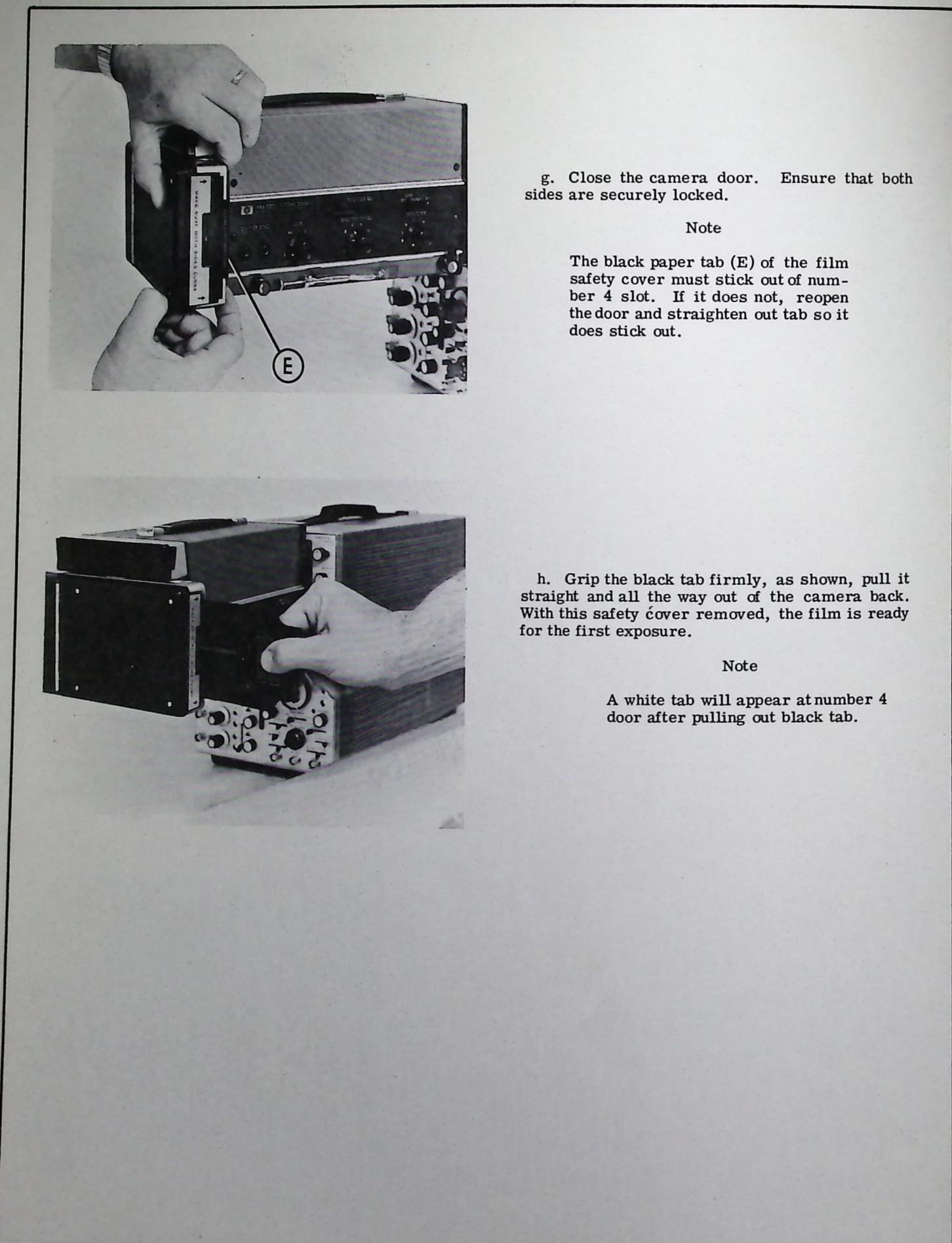


Figure 3-2. Film Loading (Sheet 3 of 3)

3-33. FOCUS

3-34. The Model 198A focus is mechanically adjustable, and is accomplished in accordance with the following steps:

Note

It is assumed that camera has been mounted on a CRT oscilloscope in accordance with Section II, and film loading has also been accomplished in accordance with Figure 3-2.

a. With camera mounted, and film pack installed, set GRATICULE switch to ON.

b. Rotate INTENSITY control to position 8.

c. Open viewer door on back of camera by rotating door lever upward.

Note

When the CRT phosphor is too far from proper focus position, a dark vertical bar

appears on center of CRT face; when CRT phosphor face is too close to proper focus position, a bright vertical bar appears on center of CRT face.

d. Observe vertical dark or bright bar on center of CRT phosphor face, through the viewing door. Rotate FOCUS control (clockwise or counterclockwise) to reduce width of the dark or bright vertical bar until it disappears. (See Figure 3-3.) The focus is now complete.

e. Position GRATICULE switch to OFF.

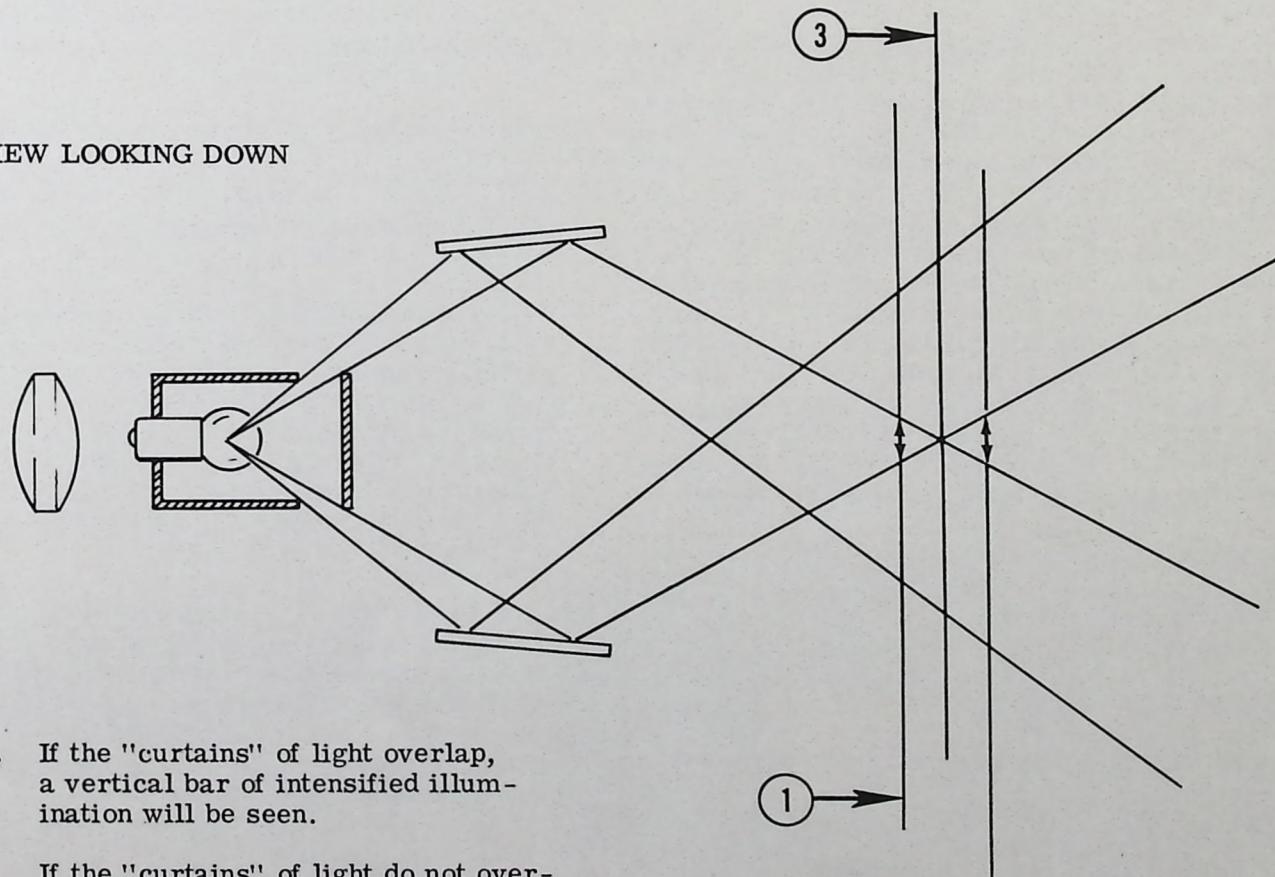
f. Close viewer door.

Note

Due to viewer having a built-in filter, door may be left open if necessary, providing ambient lighting is low. Always close door during long periods of exposure (in position B).

3-35. CAMERA CONTROL SETTINGS.

VIEW LOOKING DOWN



1. If the "curtains" of light overlap, a vertical bar of intensified illumination will be seen.
2. If the "curtains" of light do not overlap a dark bar is seen.
3. If the Lens-to-CRT distance is focused, the vertical bar disappears.

Figure 3-3. Resulting Conditions When Focusing the Model 198A

3-36. Positioning controls to the proper settings is a matter of choice to the operator, depending on type of display to be photographed. Making an average photo depends on intensity of the trace, sweep time and other factors.

3-37. Good photos are taken using average CRT intensities with the settings in Table 3-1 using Polaroid ASA 3000 film.

Table 3-1. Recommended Camera Settings

CONTROL	SETTING
LENS	f/8
SHUTTER SPEED	4 or 8 (1/4 or 1/8 second)
GRATICULE	FLASH
INTENSITY	4-6

Note

After taking some photos with the controls set as above, the operator may then, at his discretion, select different control settings to suit his own applications.

3-38. SINGLE SWEEP EXPOSURE.

3-39. Single-trace photography of fast transients is made possible by high-speed film now available. Single events which are too fast and/or faint for the eye to notice can be captured on this film. In single-trace photography, oscilloscope focus and intensity should be set up initially using a pulse generator operating at slow repetition rate (30 Hz or less) as a test signal. The low repetition rate avoids increase in trace brightness caused by phosphor persistence when traces overlap, and permits optimum CRT focus adjustment. During this initial adjustment, sweep time should be the same as used in the final photograph. To make a photograph of the desired transient, camera shutter is held open manually (by setting SHUTTER SPEED to position "B") while the oscilloscope sweep is triggered once by the signal being photographed.

3-40. To photograph a single-sweep display, proceed as follows:

- Focus camera. (See Paragraph 3-33.)
- Position GRATICULE switch to ON.
- Rotate INTENSITY control to position 8.
- Rotate SHUTTER SPEED control to position B.
- Set LENS control to f/3.5 position.

Note

These are trial settings; experience with given conditions will indicate preferred settings. Proper focus is important when large apertures are used because the depth-of-field of the lens is reduced.

f. Close viewer door.

g. Press shutter release and hold for approximately five seconds (shutter remains open as long as the shutter release is pressed). The thumb screw on the cable housing may be used to hold the shutter open.

h. Trigger single-sweep.

i. Release shutter (shutter closes).

Note

If it cannot be determined that shutter has closed, set SHUTTER SPEED control to any other setting.

j. Develop print in accordance with Figure 3-4.

3-41. SHUTTER SYNCHRONIZATION.

3-42. The SHUTTER SYNC jacks (Type X-contacts) provide a shorting action when the shutter is actuated. This feature enables synchronization of other equipment with the shutter action. For example, the single-sweep action of the oscilloscope could be triggered through this switch action; however, the mechanical delay in the actual shutter opening would have to be considered.

3-43. EXTERNAL GRATICULE CONSIDERATIONS.

3-44. Several problem areas must be considered when attempting to photograph displays on oscilloscope with an external graticule CRT.

3-45. PARALLAX. When the graticule is external to the CRT, the distance separating the phosphor and graticule causes a varying degree of refraction (refer to Paragraph 4-13). Parallax can be minimized only by positioning the graticule as close as possible to the phosphor. The CRT face should be in contact with the external graticule with no filter between them. For maximum accuracy, make scale measurements near center of the photograph.

3-46. LIGHTING. Because white light is used for graticule illumination, whereas trace fluorescence is colored, matching of trace and graticule intensities should be determined by evaluation of prints rather than by observation of the display. Best results are usually obtained with the trace appearing (to the eye) slightly dimmer than the graticule.

3-47. DEPTH-OF-FIELD. The short object-to-lens distance makes depth-of-field (refer to Paragraph 4-16) an important factor in producing a well-focused image. When large apertures are used, difficulty in focusing both on the external graticule and display will probably be encountered.

3-48. FILM DEVELOPING.

Note

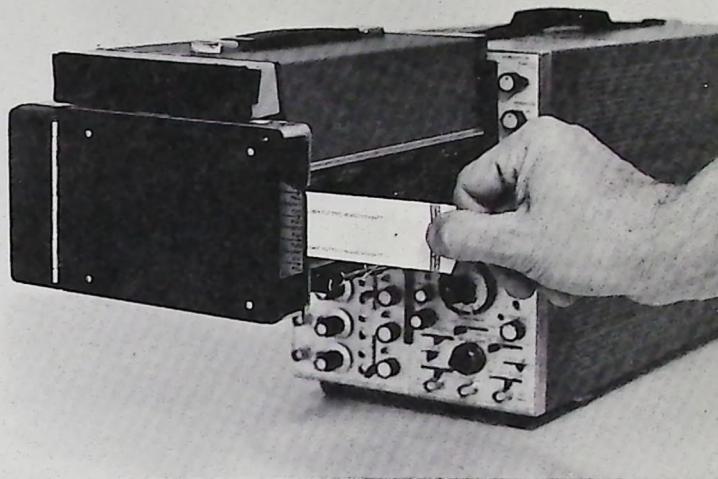
When white tab is pulled out, a concealed door pops open, and a yellow tab appears. Do not block this door in any way. Pulling out the white tab does not start development. It only prepares film for next step.

STEP 1

Grasp the white tab and pull it straight out of the camera back without hesitation.

Note

If no yellow tab appears after pulling white tab STOP, do not pull another white tab. Instead, proceed with the following sub-steps.



- a. Gently open the camera back just enough to insert a pencil or similar object on top of the film pack, to hold it in place. Do this away from bright lights.
- b. While holding film pack in place, carefully open camera door all the way. Take hold of the top-most yellow tab, and gently pull tab to remove the entire picture assembly from film pack. Ensure that film pack remains firmly seated. Discard removed photo.
- c. Close door, making sure that white tab is on the outside of its slot. Ensure that door is securely latched.
- d. Retake picture, and develop, beginning with Step 1.

Note

Performing Step 2 starts development of film.

STEP 2

Grip the yellow tab at the center and pull straight, and moderately fast, and without hesitation, all the way out of the camera back. Start timing as soon as you have pulled the yellow tab.

Note

While waiting for recommended time, do not touch bend, or lift off the print.

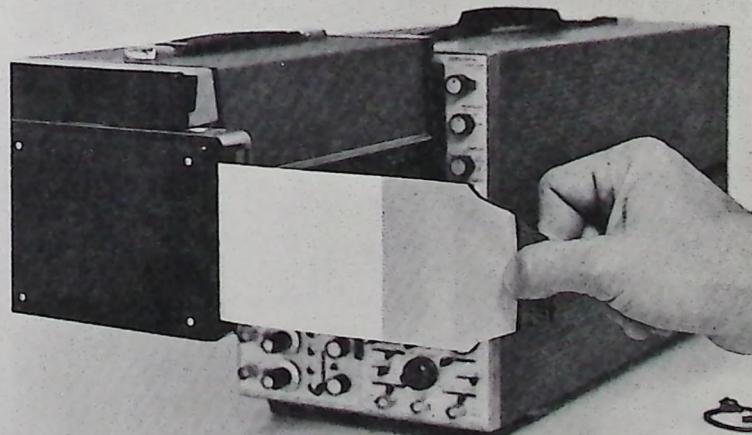
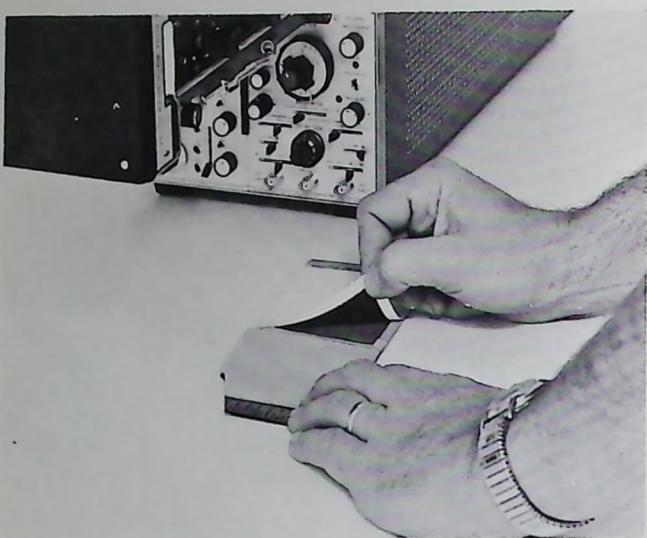


Figure 3-4. Film Developing (Sheet 1 of 2)



STEP 3

After full development time, rapidly strip the print from negative, starting at end nearest yellow tab. Never allow print to drop back onto the damp negative.

CAUTION

Discard negative. Avoid all contact with chemicals left on negative after print is removed.

Note

Prints made with some Polaroid black and white film types require coating. See your film instruction sheet which came with film pack for details. Never coat color prints.

Figure 3-4. Film Developing (Sheet 2 of 2)

3-49. Instructions for film development are covered in Figure 3-4. The development time is 10 to 15 seconds at 70° F. (21.1° C.) and above. Developing for longer periods will increase contrast, and for shorter periods will increase maximum writing rate. At temperatures lower than 70° F., the film will require a longer development period (e.g., approximately 55 to

70 seconds are required at 35° F. (1.7° C.). Refer to Figure 3-5 for developing temperatures and time.

Note

Prints should be coated as soon as possible after developing using print coater supplied with each film pack.

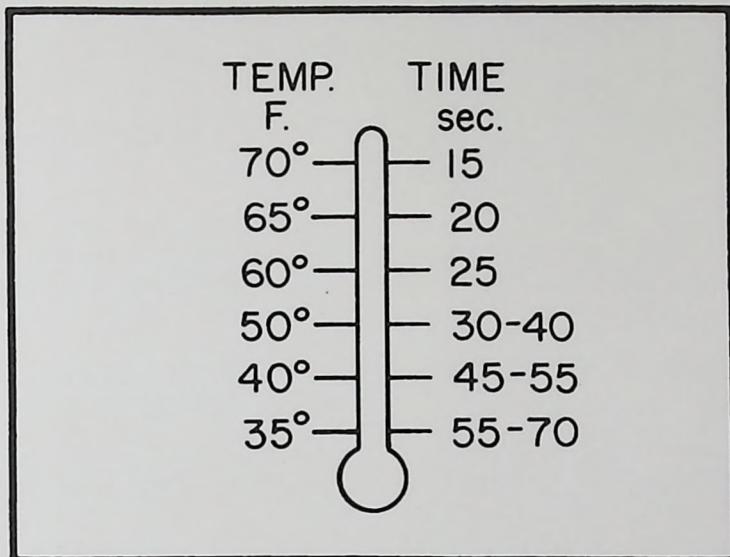
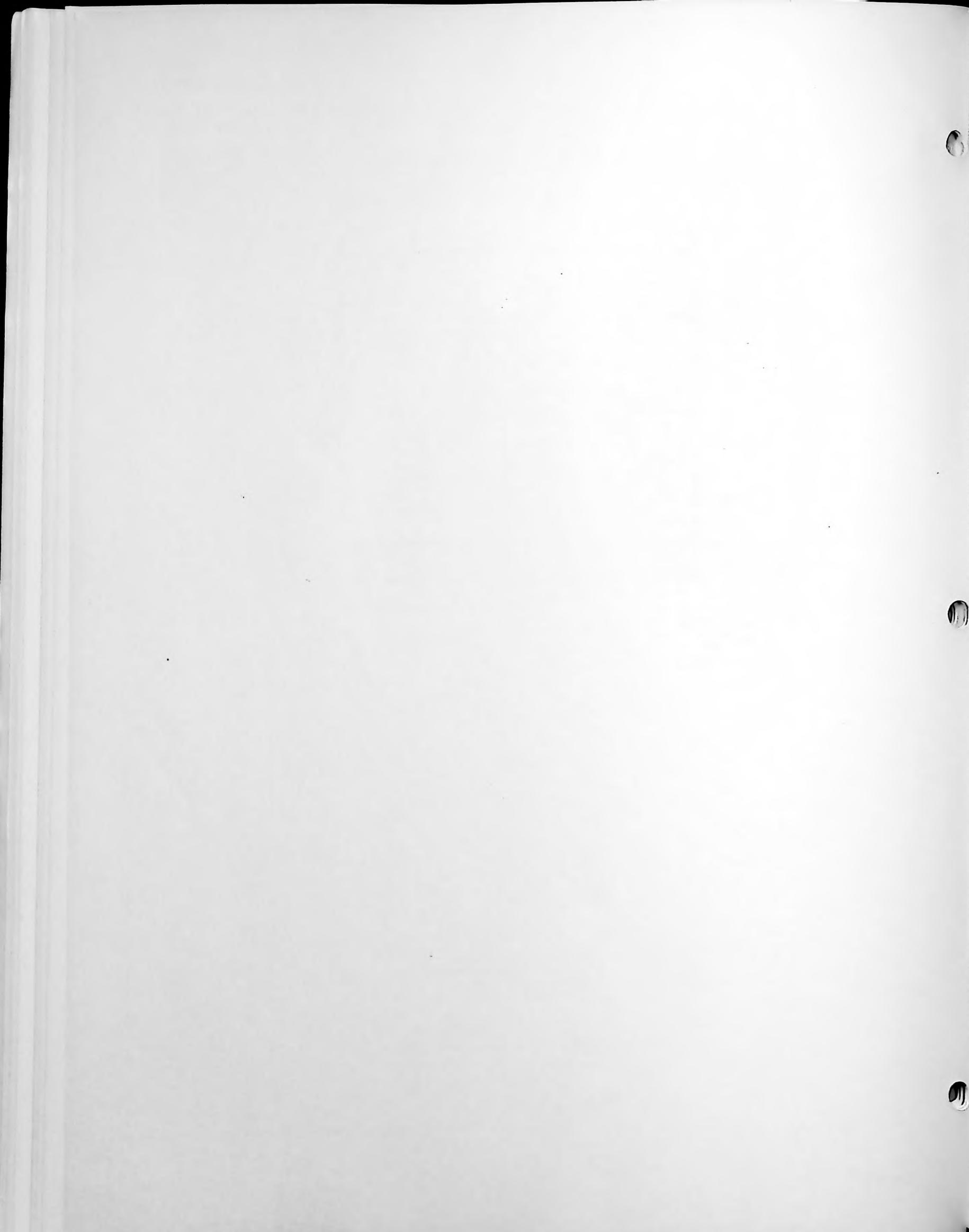


Figure 3-5. Temperature and Time for Developing



SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section consists of a general explanation on the Model 198A principles of operation. The basic functional assemblies consist of:

- a. A camera back, which retains the film pack and is also where the development begins.
- b. Internal carriage assembly (lens and shutter, and mirror and lamp assemblies), this assembly focuses and controls amount of light transmitted to the film.
- c. A control panel, which provides quick and easy accessibility for adjusting and operating the camera.
- d. Mounting clamps, which hold the camera rigidly to the oscilloscope, and provides correct spacing and alignment of the display.

4-3. CAMERA BACK.

4-4. The Model 198A uses a camera back manufactured by the Polaroid Corporation. The camera back is mounted to the Model 198A frame, and retains the film pack. The development process is initiated within this unit as described in the following paragraph.

4-5. DEVELOPMENT PROCESS.

4-6. Figure 4-1 shows how the film development process is initiated. For simplicity, only one negative and one positive are shown. The pressure plate retains the negative stack firmly against the front of the film pack cover so that the top negative in the stack lies flat in the film plane. Following the exposure, the white tab is pulled. This positions the

exposed negative over top positive of the positive stack. At the same time, white tab for the next exposure (not shown) appears at slot No. 4 opening, and the yellow tab has advanced through a second slot. Pulling yellow tab out causes the developer reagent pod to rupture when it passes between the pressure rollers. As film is drawn out of the camera, the reagent spreads in a thin layer between the positive and negative papers, and reacts with the chemicals on these papers. The finished photograph is removed by stripping the print off the negative. The print must then be coated for permanence using the coater supplied with the film.

4-7. LENS ASSEMBLY.

4-8. The Model 198A is equipped with an f/3.5 lens having a focal length of 75 mm (focal length is basically the distance from effective center of lens to the image plane when the object is viewed at infinity). The lens has been especially corrected for use in oscilloscope photography to give minimum distortion over full image area, and to give a flat field of focus.

4-9. SHUTTER ASSEMBLY.

4-10. The Model 198A is equipped with a shutter having seven calibrated time intervals from 1 to 1/60 second. Rotating the SHUTTER SPEED control one step clockwise reduces exposure by approximately one-half. One additional position is "B". In this position, the shutter remains open as long as the shutter release is pressed, and closes when released. A thumb screw on the cable housing (when tightened) prevents the shutter release from retracting and holds the shutter open and when loosened allows the shutter to close. The shutter is also equipped with a synchronizing contact (X-contact) for use with remote equipment using two sync jacks.

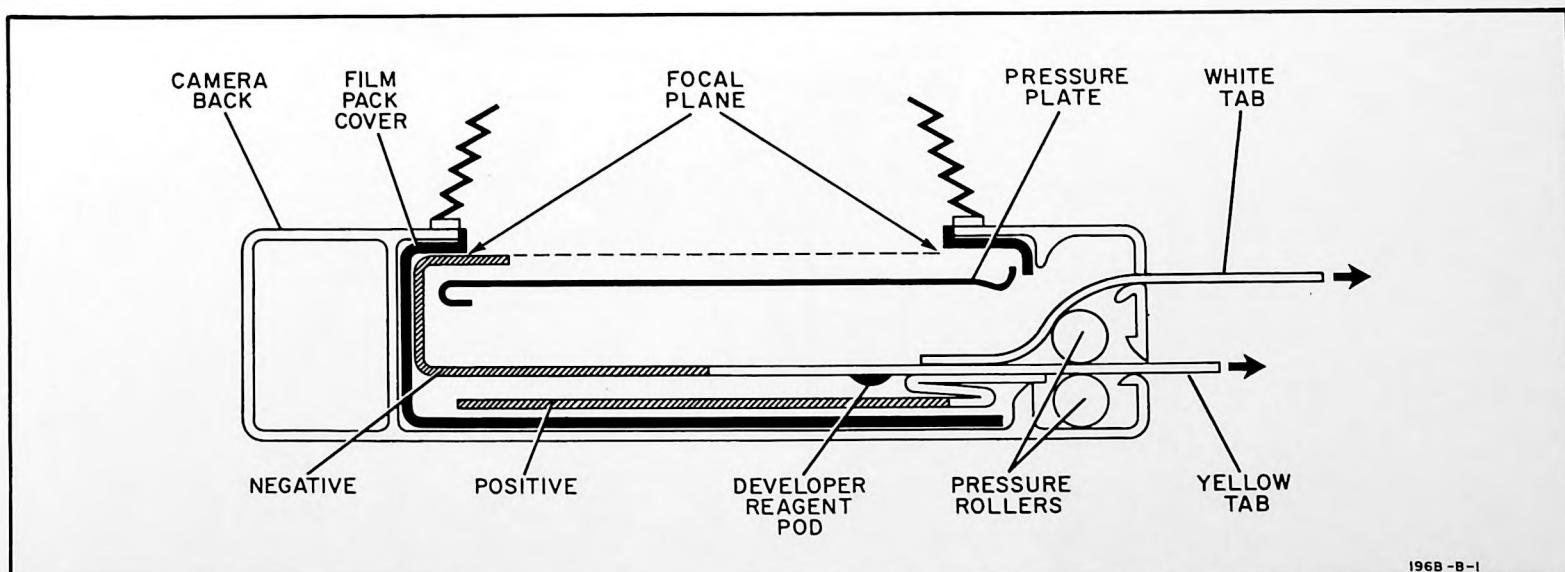


Figure 4-1. Camera Back Operation

4-11. GRATICULE ILLUMINATION.

4-12. The Model 198A uses a 6-volt dc lamp for a light source. This light is adjustable in intensity by rotating the INTENSITY control clockwise to illuminate the phosphor. Photographing this reflected light produces a gray background on the print, effectively moving zero exposure up on films exposure/density curve to a point of greater sensitivity. Then a slight

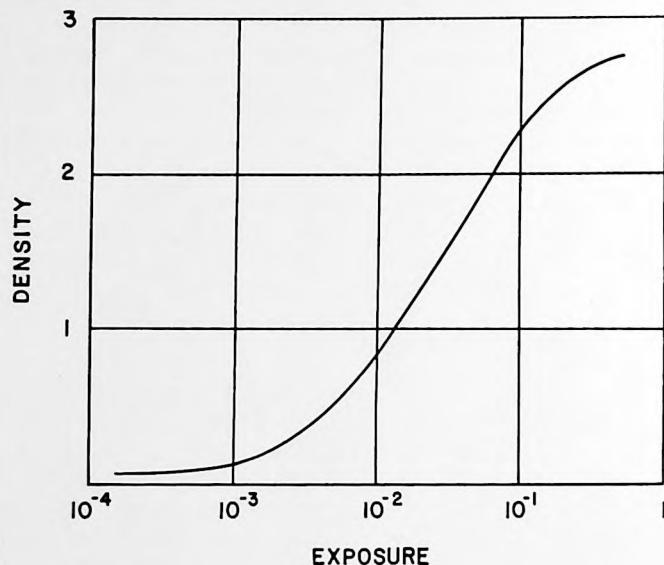


Figure 4-2. Density Exposure Curve

increase in light emitted by the CRT phosphor (such as by a very fast transient) is not required to overcome the brightness threshold level (toe of the exposure/density curve as shown in Figure 4-2), and will produce an equivalent increase in exposure. The readability of a faint trace is thus greatly improved. The net effect is an increase in maximum writing speed of the oscilloscope/camera combination. Maximum writing speed is defined as maximum spot speed, for given settings of oscilloscope and camera, which will produce a faint readable display on the film. In addition to improvement in writing speed, the light source in the Model 198A is responsible for the black graticule lines becoming visible in the photograph by contrast with the gray background.

4-13. PARALLAX.

4-14. In an internal graticule CRT, graticule lines are in the same plane as the phosphor. The arrangement eliminates any parallax between the graticule and display. With external graticule CRT's, graticule and phosphor are separated, and parallax enters into the measurement. The parallax effects are shown in Figure 4-3.

4-15. Parallax problems can be minimized by making certain that CRT face is in direct contact with the external graticule. If scale measurements are to be made from the photographs, determine the error due to parallax and make the necessary corrections when viewing display before exposure.

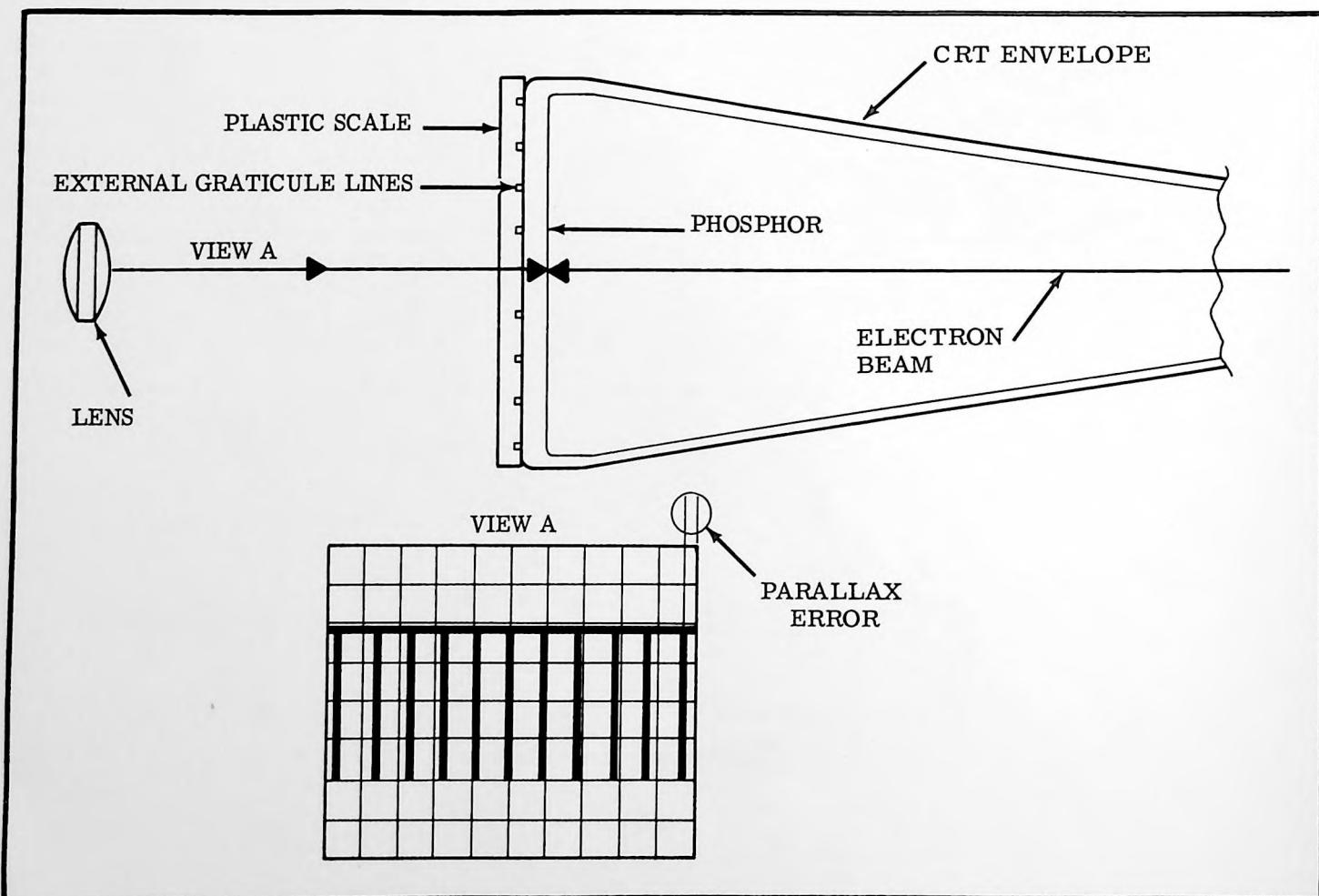


Figure 4-3. Parallax Effects

4-16. DEPTH-OF-FIELD.

4-17. An important effect to consider when using an external graticule is the depth-of-field, the range of object distances within which the image (formed on film by the lens) will be in focus. Depth-of-field has an inverse relationship with aperture size; that is, the larger the aperture, the smaller the depth-of-field. To have both an external graticule and display in focus at the same time, the aperture should be approximately f/5.6 or smaller (larger f-number).

4-18. The depth-of-field of the Model 198A lens varies with the lens f/number. For CRT phosphor surfaces not positioned at the proper focal point, the available ranges for a well-focused photograph (depth-of-field) are listed in Table 4-1. Observe that when small apertures (large f/numbers) are used, a greater depth-of-field is obtained.

Table 4-1. Lens Aperture Setting for Corresponding Depth-of-Field

APERTURE f/NUMBER	DEPTH-OF-FIELD (mm)
3.5	± 0.7
5.6	± 1.0
8.0	± 1.5
11.0	± 2.2
16.0	± 3.2
22.0	± 4.5

4-19. LIGHT CONTROL.

4-20. The light control circuitry in the Model 198A consists of a self-contained 6-volt dc power supply, using four Size-C, 1.5V dry-cell batteries, a 6-volt, 150-mA incandescent lamp, a three position GRATICULE switch, and a FLASH microswitch. The lamp is lighted when the GRATICULE switch is positioned to ON. This puts lamp, switch, and INTENSITY control in series with the power supply. The light intensity is then controlled by rotating (clockwise or counterclockwise) the INTENSITY control to desired lighting. The microswitch is mechanically connected in series with the shutter release and the shutter, and electrically connected in series with the GRATICULE switch, the INTENSITY control, and the power supply, when the switch is in the FLASH position. The shutter release is interconnected with the FLASH microswitch so that the switch operates prior to the shutter. This enables the lamp to rise to full brightness before the shutter opens.



SECTION V

MAINTENANCE

5-1. INTRODUCTION.

5-2. This section consists of maintenance and service information for the Model 198A. Improvement of print quality, performance check, troubleshooting, service, and repair are the major areas covered.

5-3. PRINT QUALITY IMPROVEMENT.

5-4. Most problems encountered in oscilloscope photography will involve incorrect control settings, or conditions of operation. These problems can often be avoided by closely following the mounting instructions (refer to Section II) and operating information (refer to Section III). A few of the most common problems are discussed in the following paragraphs.

5-5. FOGGING.

5-6. Fogging, or undesired light areas over all or part of the print, can be caused by many different factors. The two main causes are internal (within oscilloscope) or external light leakage around camera.

5-7. INTERNAL SOURCES. Many causes of fogging originate in the oscilloscope itself. These problems can be difficult to control especially when time exposures are required. Some of these faults are given below.

a. Excessive brilliance can cause a general "blooming" of the trace which tends to illuminate the entire screen. This can be corrected by decreasing display intensity.

b. Red light emitted from the cathode of a non-aluminized CRT can cause fogging on time exposures. A blue filter over the CRT face or the camera lens will be of some help in reducing cathode fogging.

c. An unblanked oscilloscope can also cause fogging, especially if it is being used for recording transients, since the spot remains visible until transient occurs. This problem can be minimized by positioning spot to a point just off the display area, by masking the spot with a small piece of tape, or turning down the intensity until the spot disappears.

5-8. EXTERNAL LIGHT INFILTRATION. External light infiltration is another common cause of film fogging. A few common sources are discussed in the following paragraphs.

a. Improper mounting may prevent the mounting frame light gasket from seating firmly against the bezel.

b. A loose fitting bezel may permit the outside light to enter the edge of the CRT face (or external graticule). Masking the edges of the bezel will usually solve this problem.

c. Loose fitting parts such as the camera top cover, the front and rear camera assemblies, may allow external light to penetrate inside of camera. These should be checked and, if possible, tightened.

d. Light entering the CRT internally through cover perforations of the instrument is more difficult to eliminate. Reduction of ambient light will probably be the most practical solution.

5-9. FILM TEARING

5-10. Film damage due to tearing is usually caused by failing to pull the yellow tab straight out when advancing the film. The tab must always be pulled in a straight line, parallel with the long axis of the camera back.

5-11. PRINT IMPERFECTIONS.

5-12. Dark spots appearing at same place on successive exposures may be caused by dust on the lens. White spots on prints can be caused by an accumulation of developer, or foreign matter on the pressure rollers in the camera back. Keeping the lens and inside of the camera back clean will eliminate most of the imperfections (refer to Paragraph 5-37 for cleaning recommendations). A diagonal pattern on all prints indicates that pressure rollers are worn or damaged.

5-13. PERFORMANCE CHECK. (See Figure 5-1)

5-14. The performance check is performed as a test to verify that the Model 198A is operating within the specifications stated in Table 1-1. This check may be used as an incoming quality control check, a periodic operational check, or a post repair check. If a malfunction occurs, refer to Section VIII.

5-15. SHUTTER OPERATION.

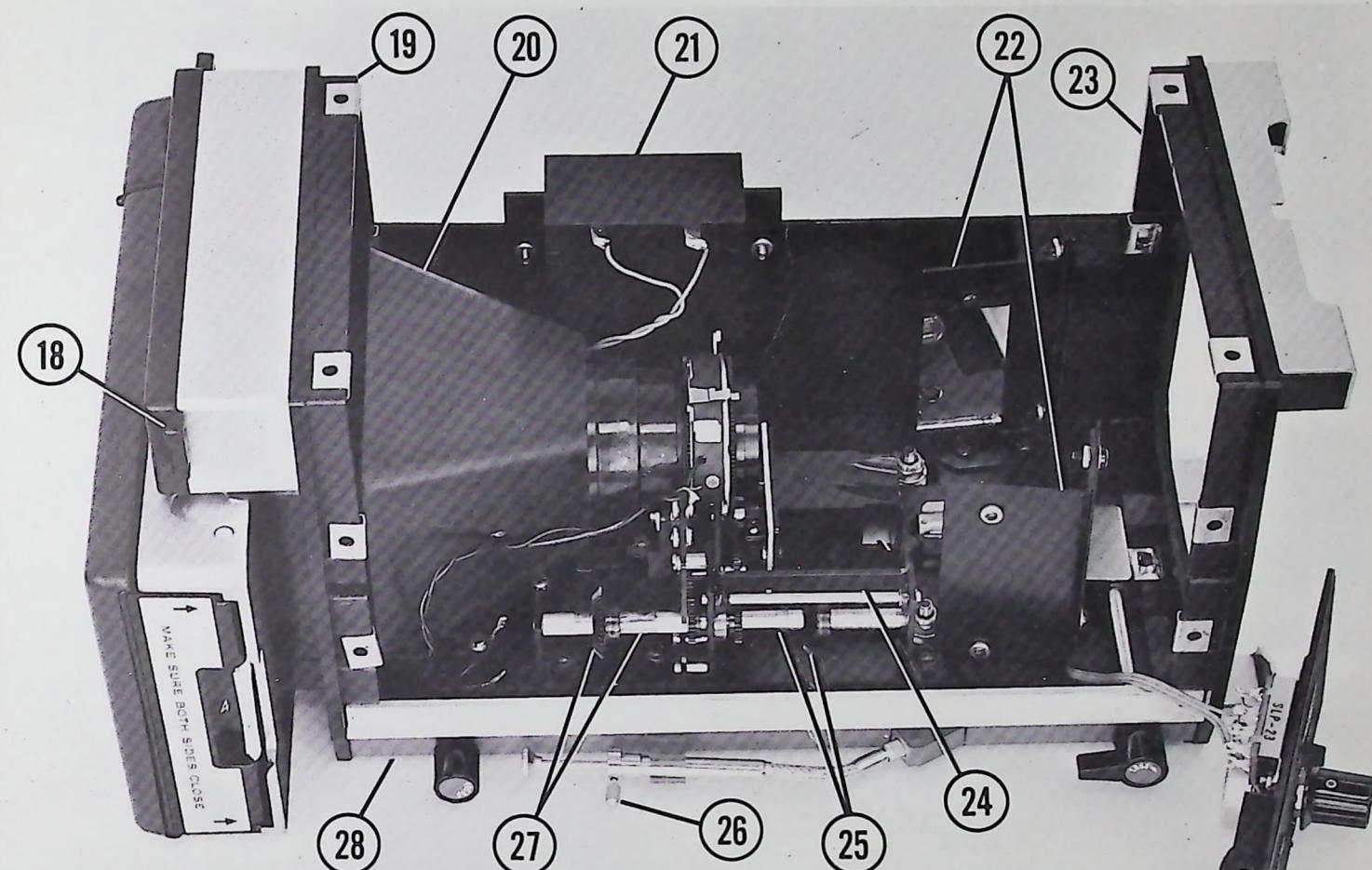
5-16. The shutter operation may be verified by performing the following steps:

Note

Remove the film pack (if applicable) and leave rear door open.



Figure 5-1. Camera Component Locations (Sheet 1 of 3)



View Looking Down, Top Cover and
Control Panel Removed

Figure 5-1. Camera Component Locations (Sheet 2 of 3)

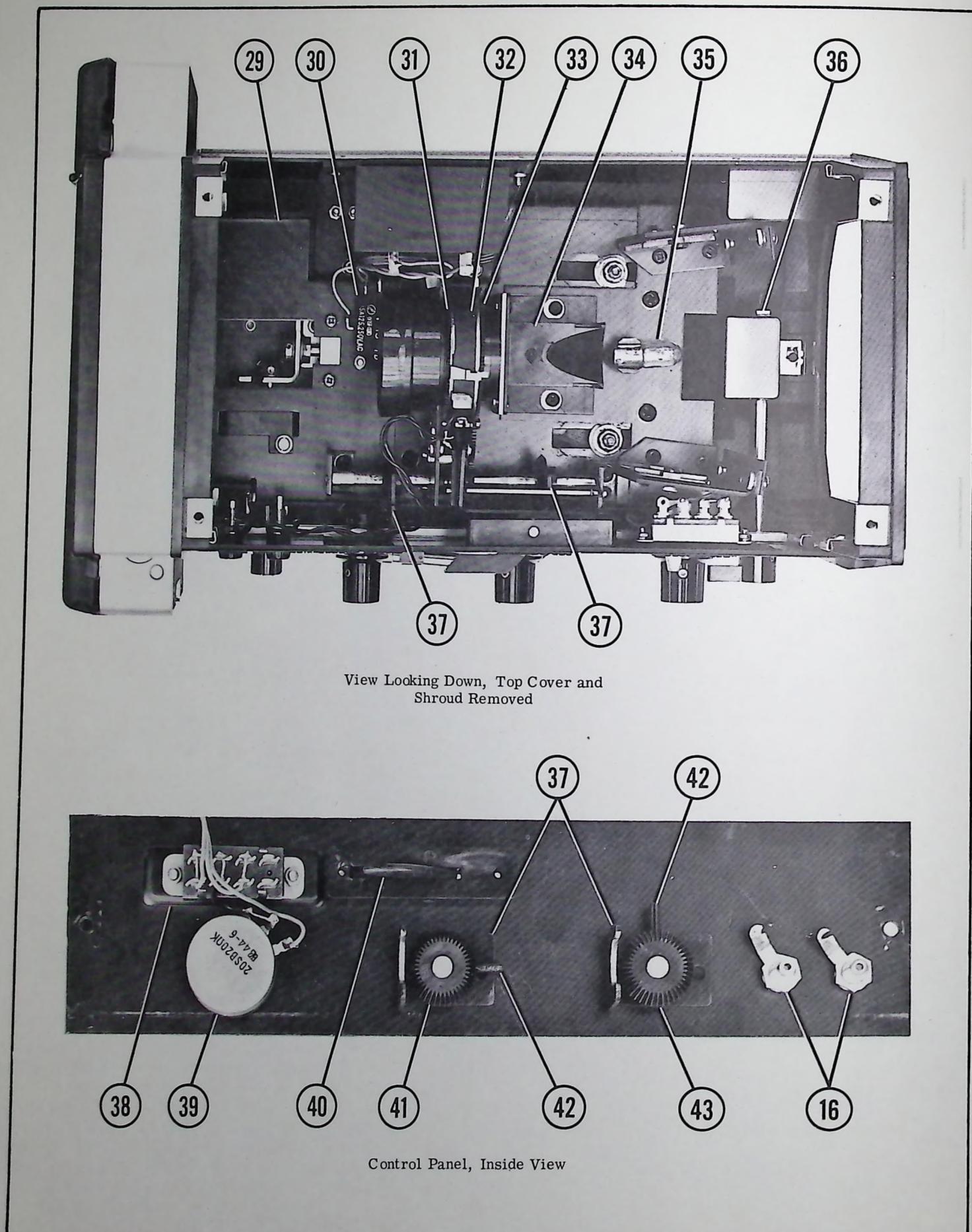


Figure 5-1. Camera Component Locations (Sheet 3 of 3)

- a. Set SHUTTER SPEED control to position 1.
- b. Push SHUTTER SET lever fully forward then release (this cocks shutter mechanism).
- c. Observing shutter from rear of camera, press shutter release and verify that shutter opens and closes.
- d. Set SHUTTER SPEED control to position B.
- e. Observing shutter from rear of camera, press shutter release and hold in pressed position. Verify that shutter opens. Release shutter and verify that shutter closes.

5-17. LENS APERTURE.

5-18. The lens aperture performance may be verified in accordance with the following steps:

Note

To observe lens aperture, remove film pack and leave rear door open if applicable.

- a. Set SHUTTER SPEED control to position B.
- b. Set LENS control to f/3.5.
- c. Press shutter release and hold in pressed position by tightening thumb screw.
- d. Observing lens from rear of camera, rotate LENS control fully clockwise and verify that aperture of lens reduces to a small opening. Then rotate control fully counterclockwise and verify aperture of lens enlarges to full opening of lens.
- e. Loosen thumb screw, allowing shutter to close.

5-19. SHUTTER SYNC.

5-20. To verify SHUTTER SYNC switch operation, the use of an ohmmeter is required. Perform the following steps to verify switch operation.

- a. Set SHUTTER SPEED control to position B.
- b. Connect ohmmeter leads to SHUTTER SYNC jacks.
- c. Press shutter release and hold. Verify shutter switch continuity on ohmmeter.
- d. Release shutter release and verify shutter switch no continuity.
- e. Remove ohmmeter leads.

5-21. LAMP OPERATION.

5-22. Operation of the graticule illumination feature is checked as follows:

- a. Verify that new batteries are installed in camera.

- b. Set GRATICULE switch to ON position.
- c. Rotate INTENSITY control to position 8.
- d. Verify that lamp is lighted.
- e. Set GRATICULE switch to FLASH position.
- f. Verify lamp not lighted.
- g. Press shutter release and verify lamp lights.
- h. Set GRATICULE switch to OFF position.

5-23. FOCUS.

5-24. The focus check is performed with camera installed on an oscilloscope, and in accordance with Section III, Paragraph 3-33.

5-25. LIGHT INFILTRATION.

5-26. Check for infiltration of light into camera as follows:

- a. Mount the Model 198A on an oscilloscope.
- b. Ensure there is no display on oscilloscope and that camera GRATICULE switch is positioned to OFF.
- c. Ensure that film has not been exposed.

Note

If film has been exposed, remove exposed print from camera back.

- d. Set SHUTTER SPEED to position 1.
- e. Push SHUTTER SET lever fully forward then release.
- f. Press shutter release.
- g. Develop the print in accordance with Figure 3-4.

Note

The resulting print should be completely black. If light infiltration occurred, refer to Paragraph 5-8 for possible causes.

5-27. ADJUSTMENTS.

5-28. There are no electrical adjustments required on the Model 198A. The mechanical adjustments are given for cases where maintenance was performed requiring removal of the control knobs or if the knobs became loose. Included are the calibration of the lens aperture and shutter speed with the external controls if, when during maintenance, the bevel drive gears were separated and required synchronization with the control knob settings. The adjustments are given as follows: (Refer to Figure 5-1 for location of controls.)

5-29. CONTROL KNOB INDEX POSITION CALIBRATION.

5-30. Calibrate INTENSITY (8), SHUTTER SPEED (10), or LENS (12) control knob index positions as follows:

- a. Rotate control shaft fully counterclockwise until stop is felt.
- b. Loosen knob setscrews.
- c. Position knob on shaft so index points to first position on control panel.
- d. Tighten setscrews.

Note

The FOCUS control knob (14) does not require adjustments.

5-31. COMPONENT AND CONTROL SYNCHRONIZATION. (See Figure 5-1 and corresponding item number for component location.)

5-32. The LENS and SHUTTER SPEED are synchronized with applicable control knobs as follows:

- a. Remove camera top (3) by removing eight screws.
- b. Remove two screws from control panel (17) and tilt panel outward enough to separate shutter and lens drive gears (41 and 43) from intermediate gears (25 and 27).
- c. Rotate lens aperture gear (31) clockwise (toward left-hand side of camera) until stop is felt.
- d. Rotate shutter speed gear (33) clockwise (toward left-hand side of camera) until stop is felt.
- e. Rotate LENS and SHUTTER SPEED control shafts (10 and 12) counterclockwise until stop is felt.
- f. Reposition control panel, ensuring that bevel drive gears mate with intermediate gears and control shafts remain at stops. Reinstall two screws in control panel. If indexes on knobs do not point to first position on control panel, refer to Paragraph 5-29 for position calibration.

5-33. MOUNTING LOCK LEVER INSTALLATION.

5-34. When installing the LOCK lever (7), ensure shaft is rotated fully counterclockwise (unlocked position). Position LOCK lever on shaft with lever pointing to the rear and parallel with base of camera and tighten set screws.

5-35. TROUBLESHOOTING.

5-36. Troubleshooting the Model 198A consists of a thorough visual inspection, mechanical and electrical checkout. For troubleshooting procedures refer to Section VIII.

5-37. CLEANING AND LUBRICATION.

CAUTION

When cleaning this instrument, do not use Freon as a cleaner.

5-38. LENS CLEANING.

5-39. The lens should be inspected regularly and cleaned as necessary. For cleaning, use lens tissue, or for stubborn smudges and grease spots (such as finger prints), a commercial lens cleaner. When cleaning the lens, avoid undue pressure so as not to remove lens coating.

5-40. CAMERA BACK CLEANING.

5-41. The entire Polaroid camera back interior should be inspected, and cleaned if necessary, before installing a new film pack. Dirt on rollers can cause repeated spots on the print. It can also prevent yellow tab from appearing at hidden door. Developer can collect at the rollers, particularly at the ends. Inspect (and clean if necessary) in accordance with Figure 5-2.

5-42. LUBRICATION.

5-43. No regular lubrication of the camera is required. However, if there is a noticeable binding at any points listed in Table 5-1, a small amount of lubrication should be applied as specified.

5-44. REPAIR AND REPLACEMENT.

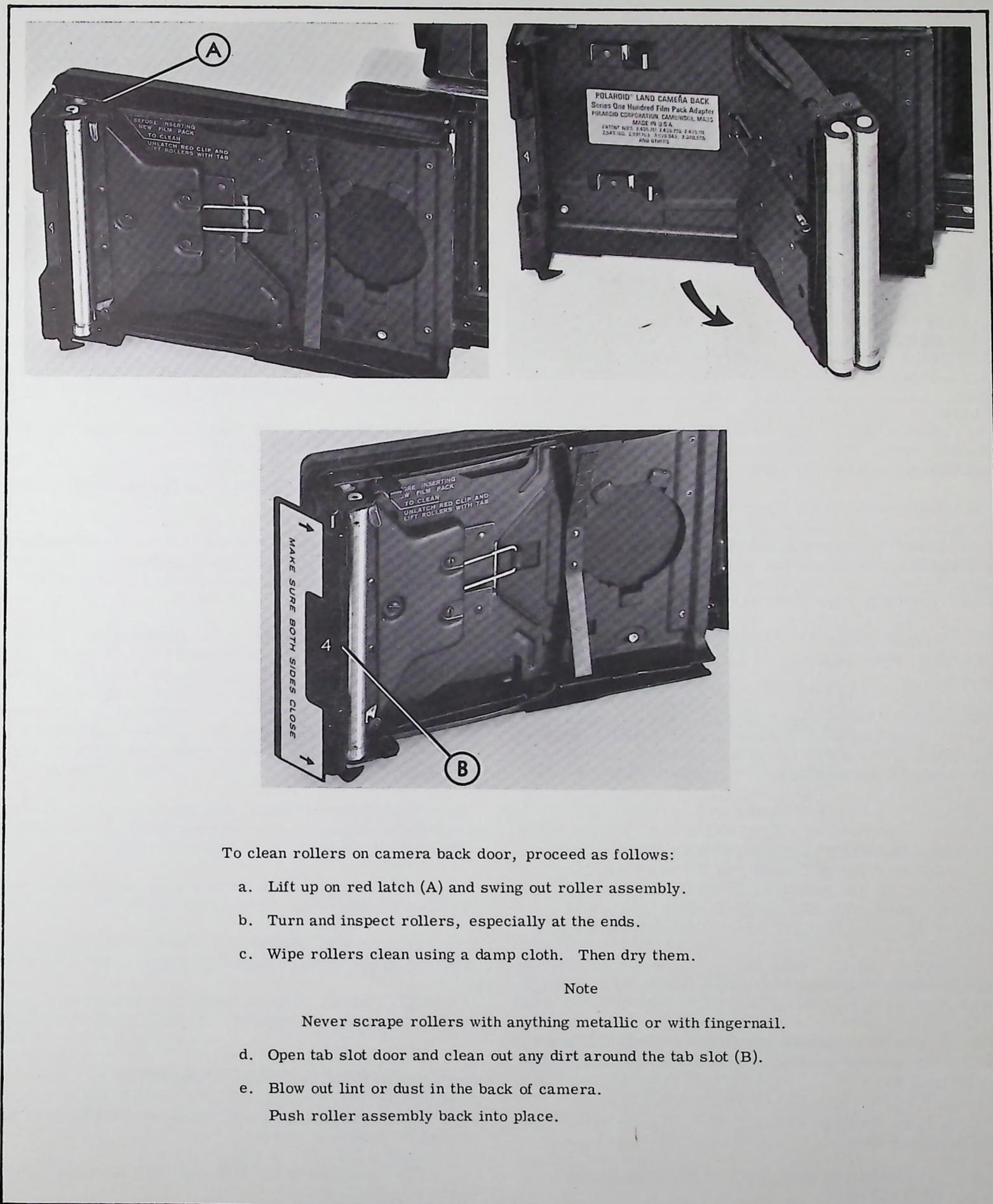
5-45. Repair of the Model 198A consists of replacing components found to be defective during troubleshooting or damaged from other causes. The following paragraphs provide information for replacement of those defective or damaged components. If for some reason satisfactory operation or repair cannot be accomplished, contact the nearest Hewlett-Packard Sales/Service Office (refer to last pages in this manual for addresses). If shipment of camera to the Sales/Service Office for repair is recommended, refer to Section II for repackaging information. (Refer to Figure 5-1, and applicable index number as referred to for component location. Numbers in parenthesis, used in procedural steps, refer to the component index number in the figure.)

Note

The components covered in the Repair and Replacement paragraphs are those components which would most likely need replacing due to failure or damage. Figure 6-1 (illustrated parts breakdown) can be helpful for finding replacement components also for those not covered in the following paragraphs.

5-46. CONTROL PANEL REMOVAL.

- a. Remove camera top (3) by removing eight Phillips screws.
- b. Remove two Phillips screws from control panel (17).



To clean rollers on camera back door, proceed as follows:

- Lift up on red latch (A) and swing out roller assembly.
- Turn and inspect rollers, especially at the ends.
- Wipe rollers clean using a damp cloth. Then dry them.

Note

Never scrape rollers with anything metallic or with fingernail.

- Open tab slot door and clean out any dirt around the tab slot (B).
- Blow out lint or dust in the back of camera.

Push roller assembly back into place.

Figure 5-2. Roller Assembly Maintenance

Table 5-1. Camera Lubrication Points

COMPONENT	LOCATION FIGURE and INDEX NO.	RECOMMENDED LUBRICANT
Focus wormgear	6-4, (8)	Lubriplate
Focus drive bevel gears (2 places)	6-4, (5)	Lubriplate
Lens control drive shaft and bevel drive gears (2 places)	5-1, (27) (43)	Lubriplate
Shutter speed control drive shaft and bevel drive gears (2 places)	5-1, (25) (41)	Lubriplate
Focus control drive shaft	6-4, (3)	Lubriplate
Lens and shutter speed intermediate drive shafts (2 places)	6-2, (24) (43)	Lubriplate
Lock lever shaft	6-4, (39)	Lubriplate

c. Rotate LENS (12) and SHUTTER SPEED (10) control knobs fully clockwise. Tip panel outward and remove upper bezel (6) from panel.

d. Lift panel out of lower bezel (6).

e. Unsolder wires from GRATICULE switch and INTENSITY potentiometer.

5-47. CONTROL PANEL INSTALLATION.

a. Solder wires to GRATICULE switch and INTENSITY potentiometer in accordance with Figure 8-1.

b. Insert control panel (17) in lower bezel groove. Ensure panel seats all the way down in groove, and that LENS and SHUTTER SPEED controls (10 and 12) are rotated fully clockwise.

Note

When installing panel, ensure that the intermediate drive gears (25 and 27) are positioned on the rear side of bracket (37) so they will mate with the control drive gears (41 and 43).

c. Insert upper bezel (6) on top edge of control panel. Ensure that panel edge is all the way in bezel groove.

d. Synchronize LENS and SHUTTER SPEED controls and secure control panel in accordance with Paragraph 5-32.

e. Install camera top (3) and secure with eight Phillips screws.

5-48. INTENSITY CONTROL (POTENTIOMETER) REPLACEMENT.

a. Removal of the INTENSITY control (39) may be accomplished as follows:

(1). Remove INTENSITY control panel in accordance with Paragraph 5-46.

(2). Remove control knob (8) by loosening two setscrews in knob.

(3). Remove nut and star washer, and remove INTENSITY control from panel along with three flat washers and a star washer. Retain attaching hardware for reinstallation.

(4). Unsolder wires from INTENSITY control.

b. Installation of INTENSITY control (39) may be accomplished as follows:

(1). Connect and solder wires to INTENSITY control in accordance with wiring schematic in Figure 8-1.

(2). Position three flat washers and one star washer retained in Step a.(3) over shaft of control and insert shaft through hole in control panel (17).

(3). Position one star washer over shaft, install and tighten nut.

(4). Install control knob and calibrate index position in accordance with Paragraph 5-29.

(5). Install control panel (17) in accordance with Paragraph 5-47.

5-49. GRATICULE SWITCH REPLACEMENT.

a. Removal of the GRATICULE switch (38) may be accomplished as follows:

(1). Remove control panel (17) in accordance with Paragraph 5-46.

(2). Remove three control knobs (8, 10 and 12) on control panel by loosening two set screws each.

(3). Remove nuts and washers from all three shafts and from SHUTTER SYNC jacks (15). Retain attaching hardware for reinstallation.

(4). Remove control panel nameplate mask.

(5). Remove two screws that secure switch to panel, and remove switch and mask. Retain screws and mask for reinstallation.

(6). Unsolder wires from switch.

b. Installation of GRATICULE switch (38) may be accomplished as follows:

(1). Connect and solder wires to GRATICULE switch in accordance with wiring schematic in Figure 8-1.

(2). Position switch to control panel with control inserted through slot and install two screws. Position switch mask over switch control.

(3). Position control panel nameplate mask to control panel and reinstall nuts, washers, and SHUTTER SYNC jacks (15), retained in Paragraph 5-49, step a.(3).

(4). Install control panel (17) in accordance with Paragraph 5-47.

(5). Install control knobs (8, 10 and 12) and calibrate index positions in accordance with Paragraph 5-29.

5-50. SHUTTER SET LEVER REPLACEMENT.

a. Removal of the SHUTTER SET lever (11) may be accomplished as follows:

(1). Remove control panel (17) in accordance with Paragraph 5-46.

(2). Remove control panel nameplate mask from control panel in accordance with Paragraph 5-49, Steps a.(2) thru (4).

(3). Remove two screws securing set lever to control panel and remove lever.

b. Installation of SHUTTER SET lever (11) may be accomplished as follows:

(1). Position SHUTTER SET lever to control panel with lever inserted through slot in panel. Secure with two screws.

(2). Position control panel nameplate mask to control panel and reinstall nuts and washers on control shafts, and reinstall sync jacks.

(3). Install control panel (17) in accordance with Paragraph 5-47.

(4). Install control knobs (8, 10 and 12) and calibrate index positions in accordance with Paragraph 5-29.

5-51. MICROSWITCH "FLASH" REPLACEMENT. (See Figures 5-1 and 8-1.)

a. Removal of the microswitch (30) may be accomplished as follows:

(1). Remove camera top (3) by removing eight screws.

(2). Rotate FOCUS control (14) counterclockwise until inner carriage assembly has fully retracted to rear of camera.

(3). Turn camera bottom-side up, and remove two screws in rear of carriage assembly (these secure shroud to the carriage). (See Figure 6-1, Item 24.)

(4). Open door in camera back and remove plate which retains pen nuts for the two screws just removed.

(5). Slide camera back (1) and shroud (20) to the rear and out of camera.

(6). Remove control panel (17) in accordance with Paragraph 5-46.

(7). Remove two nuts, washers, and two special teflon washers from forward end of carriage at the two forward guide slots and two screws which secure aft of carriage to worm-screw nut. (See Figure 6-1.)

Note

When removing carriage, observe position of wiring under carriage for correct positioning when reinstalling carriage.

(8). Lift carriage out of camera body.

(9). Remove two nuts, washers, and screws which secure microswitch (30) to carriage. Retain hardware including switch actuator for reinstallation.

(10). Unsolder wires from switch.

b. Installation of microswitch (30) may be accomplished as follows:

(1). Connect and solder wire to microswitch (30) in accordance with schematic in Figure 8-1.

(2). Position actuator and microswitch to carriage base in line with applicable holes and insert (from the bottom) two screws. Install two washers and nuts, and tighten.

Note

Ensure wire cable is in correct position.

(3). Position carriage in place so that two screws fit into both guide slots at forward end of carriage. Ensure guide spacers are positioned in slots.

(4). Align the two holes at rear of carriage with holes in worm-screw nut, and install two screws.

(5). With carriage halfway forward, position two teflon washers on screws with square sides facing inboard and forward. Install two flat washers and nuts. Do not tighten nuts, leave slightly loose so carriage will travel with ease.

(6). Rotate FOCUS control knob (14) fully counterclockwise until carriage has traveled aft to full stop.

(7). Position camera back (1) with shroud (20) attached to rear of carriage and align with two holes in bottom of carriage. Position plate removed in Step a.(4) over the two holes and install two screws (from the bottom of carriage) through plate, and tighten.

(8). Rotate FOCUS control knob (14) clockwise until carriage has traveled half way forward.

(9). Install control panel (17) in accordance with Paragraph 5-47.

5-52. LAMP REPLACEMENT.

5-53. Replace defective lamp as follows:

- a. Remove camera top cover (3).
- b. Gaining access through front of camera, loosen two screws in vertical flange of lamp cover (34).
- c. Lift up and pull forward on cover and remove.
- d. Remove lamp (bayonet type) and replace with spare lamp (35) located just forward of lamp cover.

Note

If filament location in lamp is different from that replaced, it will affect the focusing and will therefore require adjustment. If so, proceed with Step e. If filament location is the same, omit Steps e through g and proceed with step h.

- e. Loosen lamp socket retaining screw.
- f. Shift the lamp forward or to the rear so as to position the filament in line with the two lamp bracket screws.

Note

Ensure that socket terminals do not touch lens assembly.

g. Tighten lamp socket. Use caution not to over-tighten.

h. Reposition lamp cover and tighten two retaining screws.

Note

A new spare lamp should be inserted in spare lamp holder as soon as possible so a spare lamp is always available.

- i. Reinstall camera top cover.

5-54. CAMERA BACK REPLACEMENT.

a. Removal of the camera back (1) may be accomplished as follows:

(1). Open camera back door by tripping latch (16) under door opening, and swing door fully open.

(2). Remove four screws, two at top and two at bottom. Remove camera back.

b. Installation of camera back may be accomplished as follows:

(1). Open door on camera back.

(2). Position camera back (1) to shroud (20) so that top and bottom holes align. Install four screws. Do not over-tighten. Close door.

5-55. BATTERY REPLACEMENT.

a. Turn camera upside-down, and remove two retaining screws in the battery cover. Remove cover.

Note

A block diagram located inside battery compartment shows position of batteries when installed.

b. Remove old batteries from battery compartment (21).

c. Install fresh batteries in battery compartment in position shown on block diagram.

d. Replace battery cover and secure with two screws.

CAUTION

If at any time the Model 198A will not be in use for long periods, it is recommended that batteries be removed to protect the instrument from damage due to leakage of electrolyte.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replaceable parts for the Model 198A. Figure 6-1 shows an assembly breakdown of the Model 198A, including reference index numbers used in the parts listing to aid in locating applicable part numbers for replacing defective or damaged parts. A brief outline in the following steps explain the use of Figure 6-1.

- a. Turn to Figure 6-1.
- b. Locate the applicable part or the assembly in which the part is contained. Note the index reference number.
- c. Refer to the parts listing and locate the index number in the first column. The second column contains the HP part number. The third column gives the total quantity of that part used in the camera. In the last column, a description of the part or assembly is listed. If this happens to be an assembly and the part required is located in this assembly, the assembly parts breakdown figure will be referenced in the description of assembly.
- d. If a reference is made to another figure, refer to that figure. Locate part required. Then refer to that figure's part list and locate the applicable part number and nomenclature.

6-3. ORDERING INFORMATION.

6-4. To place an order for a replacement part(s) with the Hewlett-Packard Company, address order or

inquiry to the nearest Hewlett-Packard Sales/Service Office (see list of addresses in the last pages of this manual) and supply the following information:

- a. the Hewlett-Packard part number and quantity of part(s) required.
- b. model number and eight-digit serial number of the instrument.

6-5. To place an order for a part not listed in Figure 6-1 or other applicable figure parts list, provide the following information:

- a. model number and eight-digit serial number of the instrument.
- b. description of part including function and location.

6-6. Component descriptions listed in the applicable figures are as complete as possible to assist in obtaining replacement parts from manufacturers other than HP. However, many parts are manufactured by HP or are produced by other manufacturers to HP proprietary specifications. Manufacturer's part number for non-HP parts will be supplied upon request. Contact nearest Hewlett-Packard Sales/Service Office for further information or to order parts. Parts that are not in inventory at the HP Sales/Service Office are ordered through the Hewlett-Packard nation-wide computer system, and are normally shipped from the regional service center or factory within 24 hours.

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
1	00109-7021	1	Camera Back
2	1460-0311	1	Spring, Viewer Door
3	00198-5042	1	Frame, Viewer Window
4	00198-5043	1	Door, Viewer
5	00198-1040	1	
6	00198-5022	1	Frame, Rear Camera
7	2460-0004	2	Screw, Machine (#6-32)
8	2460-0001	2	Screw, Machine
9	2190-0007	2	Washer

Figure 6-1. Camera Major Parts and Assemblies (Sheet 1 of 3)

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
10	00198-1001	1	Cover, Camera Top
11		8	Screw, Machine
12	0590-0049	2	Nut
13	3050-0071	2	Washer, Flat
14	00198-3031	2	Washer, Teflon
15		2	Spacer, Guide
16	No Number	1	Camera Base Assembly (See Figure 6-4)
17	00198-1044	1	Plate, Front Frame
18	00198-5021	1	Frame, Front Camera
19	00198-8501	1	Gasket, Front Frame
20	00198-1021	1	Clamp, Upper
21	2370-0008	4	Screw, Machine (#6-32)
22	2210-0002	2	Screw, Machine (#4-40)
23	No Number	1	Mirror and Lamp Assembly (See Figure 6-3)
24	2370-0013	2	Screw, Machine
25	4204-3040	2	Screw, Machine
26	00198-1051	1	Bracket
27	2190-0004	2	Washer
28	2260-0001	2	Nut
29	No Number	1	Control Panel Assembly (See Figure 6-5)
30	2460-0003	2	Screw, Machine
31	7200-0273	1	Bezel, Lower
32	7200-0273	1	Bezel, Upper
33	No Number	1	Carriage and Lens and Shutter Assemblies (See Figure 6-2)
34	00198-3046	1	Filter, Viewer
35	00198-5027	1	Shroud
36	00198-1041	1	Plate
37	2220-0004	2	Screw, Machine
38	2290-0002	2	Screw, Machine

Figure 6-1. Camera Major Parts and Assemblies (Sheet 2 of 3)

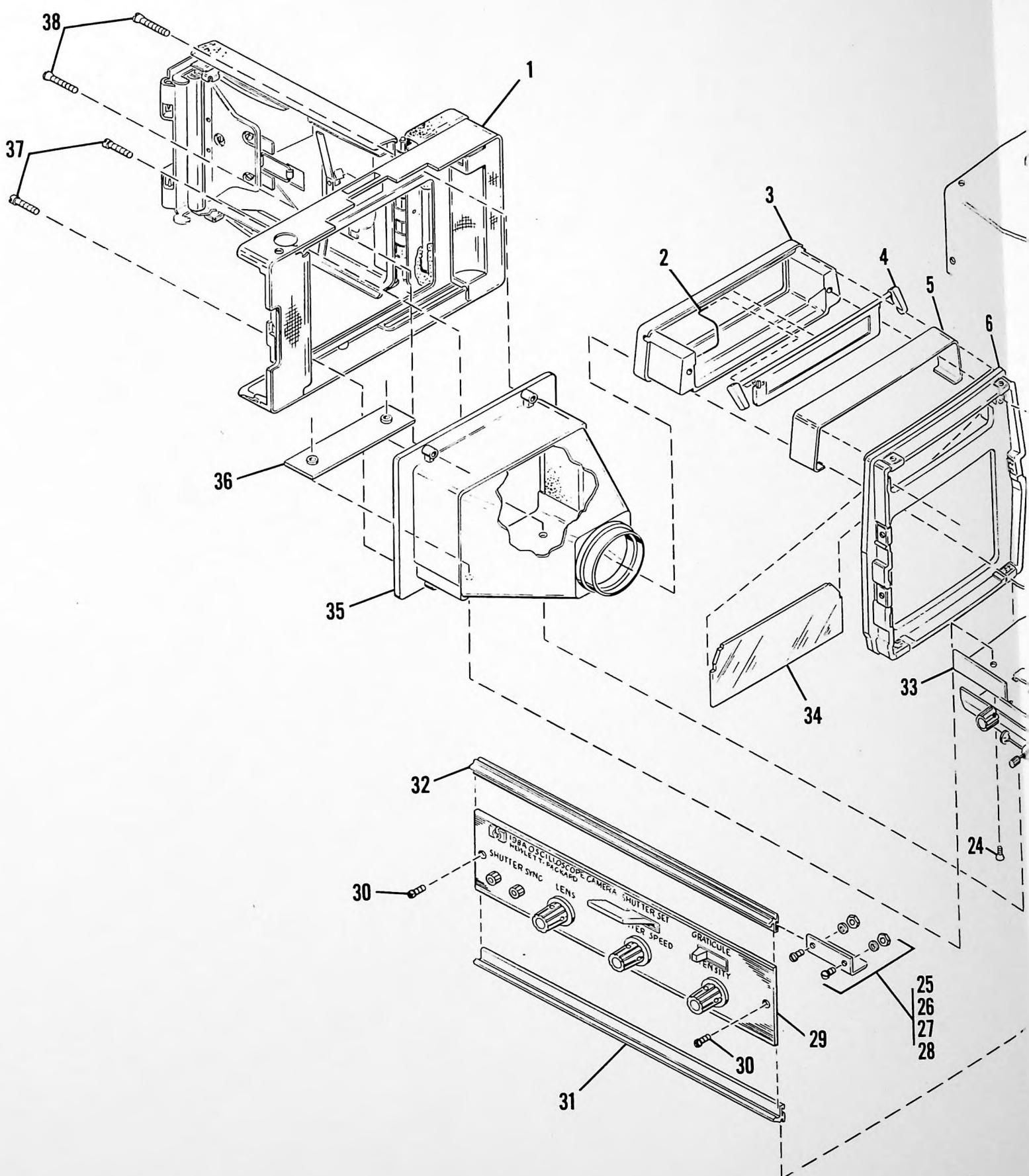
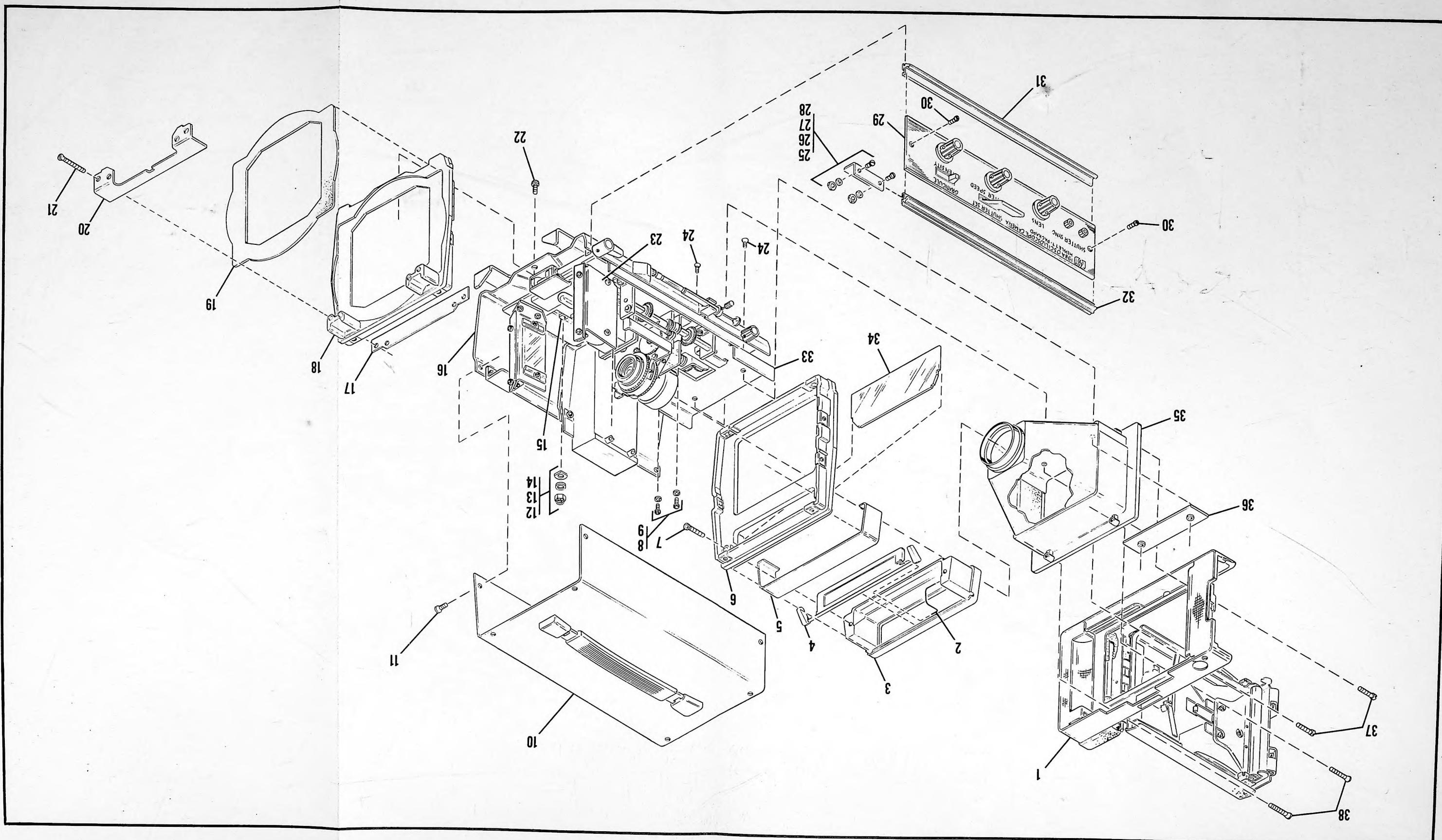


Figure 6-1. Camera Major Parts

Figure 6-1. Camera Major Parts and Assemblies (Sheet 3 of 3)



INDEX NO.	PART NUMBER	TQ	DESCRIPTION
1		1	
2		1	Lens, Rear
3		1	
4	00198-3028	1	
5	00198-5045	1	Cap
6	2460-0001	4	Screw, Machine (#6-32)
7	2190-0007	4	Washer
8	00198-1027	1	Bracket, Lens and Shutter Stand-off
9	2200-0103	1	Screw, Machine
10	00198-1045	1	Spring
11	00198-3027	1	Ring, Shutter
12	00198-5028	1	Gear, Shutter Aperture
13		1	Shutter Assembly
14	00198-1049	1	Spacer, Shutter
15	No Number	1	Gasket
16	00198-5033	1	Gear, Shutter Speed
17		1	Lens Assembly
18	0510-0015	4	Retainer
19	00198-1030	1	Bracket, Support
20	00198-5032	2	Gear, Intermediate Bevel
21	00198-3044	1	Shaft
22	00198-1033	1	Bracket
23	1460-0308	1	Spring
24	00198-3035	1	Shaft, Shutter Speed Intermediate Drive
25	00198-3045	1	Pin
26	00198-5030	2	Gear
27	00198-3032	1	Bushing
28	00198-1032	1	Arm
29	00198-5029	2	Gear
30	00198-3033	1	Shaft
31	2230-0004	6	Screw, Machine

Figure 6-2. Camera Carriage and Lens and Shutter Assemblies (Sheet 1 of 3)

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
32	2190-0004	6	Washer
33	0360-0702	1	
34	00198-1029	1	Plate
35	00198-3034	3	Stud
36	00198-1026	1	Chassis, Carriage
37	2200-0170	2	Screw, Machine
38	3101-0257	1	Actuator, Microswitch (JV-5-J)
39	3101-0256	1	Microswitch (V3-1-D8-J)
40	2190-0043	2	Washer
41	2260-0002	2	Nut
42	00198-1047	1	Stopper
43	00198-3030	1	Shaft, Lens Intermediate Drive
44	00198-3039	1	Boss
45	00198-1028	1	Bracket
46	1460-0309	1	Spring
47	00198-5037	1	Arm
48	00198-3048	1	Spacer
49	0510-0045	1	Retainer

Figure 6-2. Camera Carriage and Lens and Shutter Assemblies (Sheet 2 of 3)

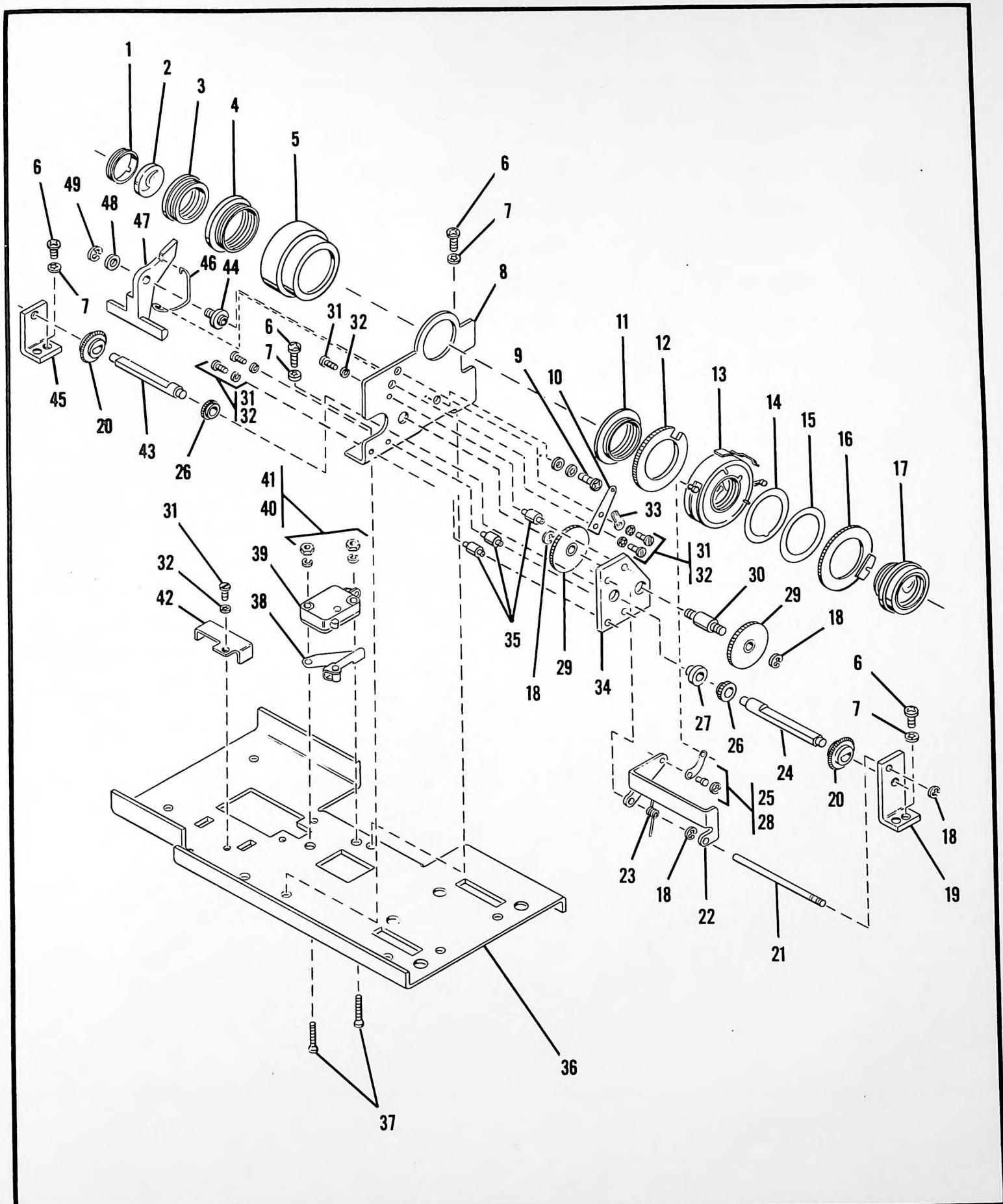


Figure 6-2. Camera Carriage and Lens and Shutter Assemblies (Sheet 3 of 3)

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
1	1450-0206	1	Socket, Lamp
2	2200-0003	1	Screw, Machine
3	00198-5039	1	Cover, Lamp
4	2200-0139	13	Screw, Machine (#4-40)
5	00198-1035	1	Bracket, RH Mirror
6	00198-5049	4	Retainer, Mirror
7	00198-8502	2	Mirror
8	00198-1036	1	Bracket, LH Mirror
9	00198-1038	2	Plate, Mirror Bracket
10	2190-0004	4	Washer
11	2140-0009	2	Lamp, Incandescent (6V, 150ma bayonet base)
12	00198-1034	1	Plate, Lamp and Mirror Assy Base
13	1400-0076	1	Holder, Spare Lamp
14	2200-0166	1	Screw, Machine (#4-40)
15	00198-1037	1	Bracket, Lamp
16	2260-0002	1	Nut
17		1	Washer
18	00198-5054	1	Holder, Lamp
19	2190-0004	2	Washer
20	2260-0008	2	Nut

Figure 6-3. Camera Mirror and Lamp Assembly (Sheet 1 of 2)

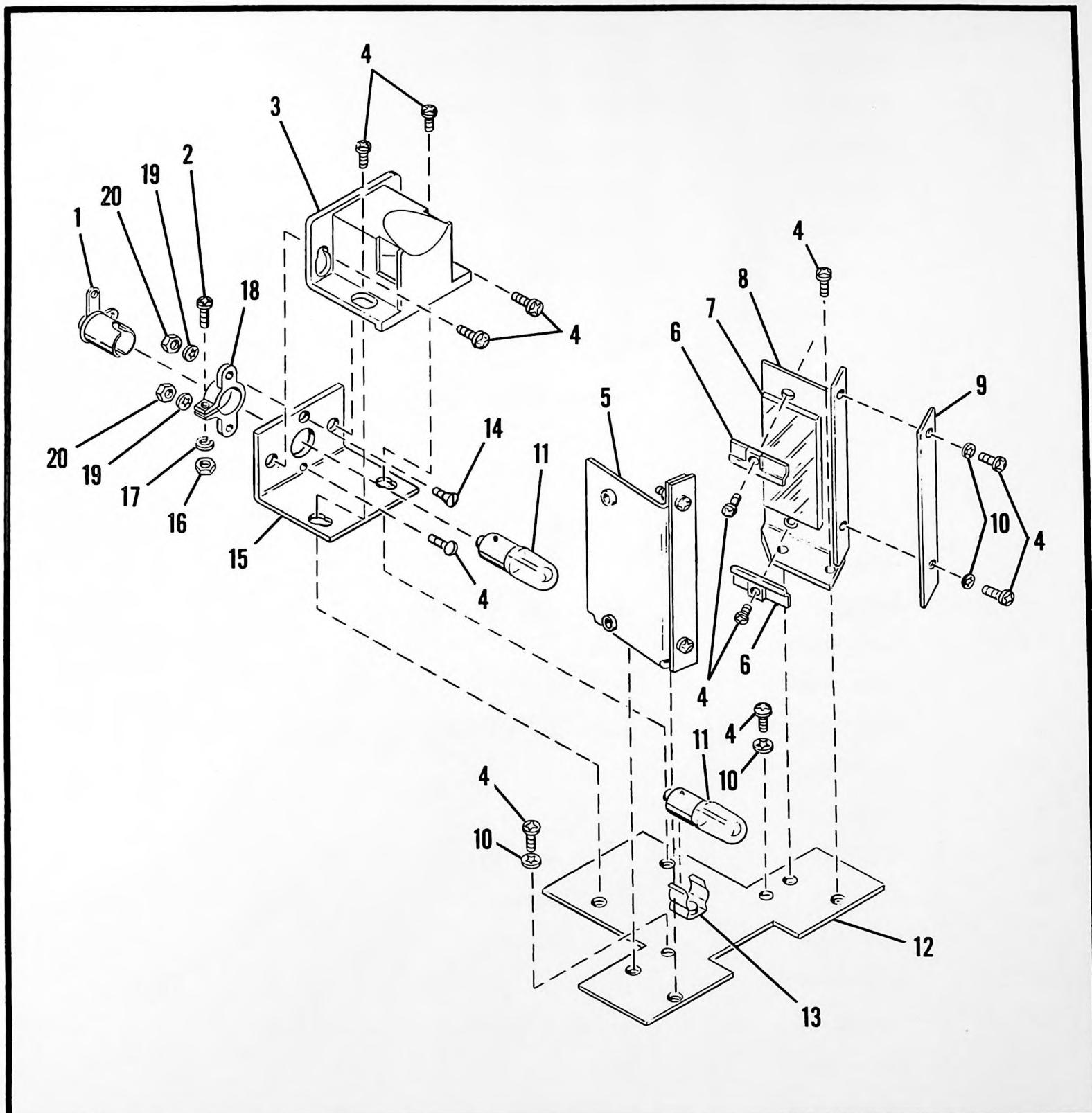


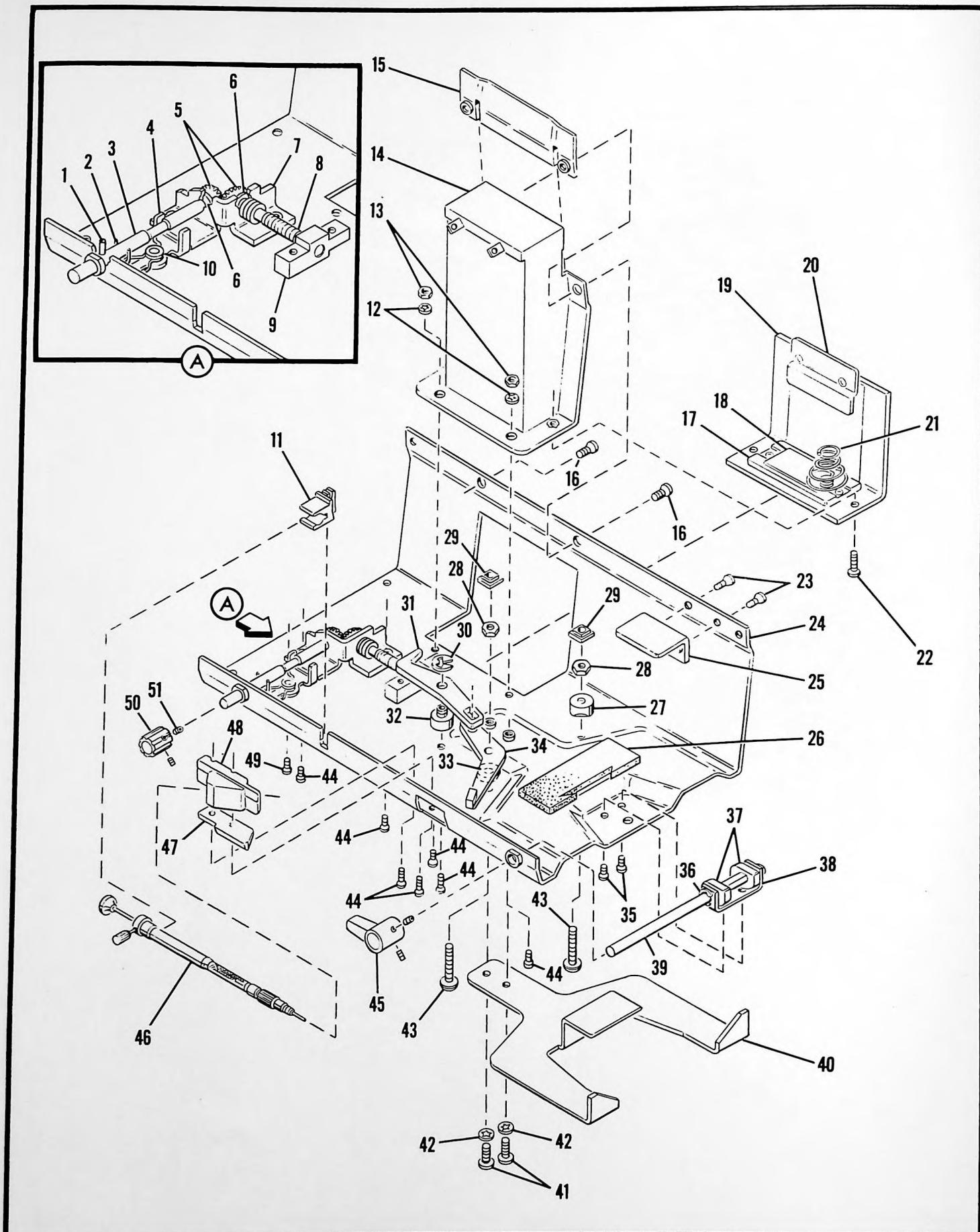
Figure 6-3. Camera Mirror and Lamp Assembly (Sheet 2 of 2)

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
1	1480-0007	1	Pin, Stop
2	1460-0310	1	Spring
3	00198-3041	1	Shaft, Focus Control Drive
4	00198-1046	1	Bracket, Carriage Stop
5	00198-3042	2	Gear, Bevel
6	00198-3048	2	Spacer, Teflon
7	00198-1031	1	Bracket
8	00198-3040	1	Worm Gear
9	00198-3043	1	Nut, Carriage Travel
10	00198-3050	1	Boss
11	00198-5024	1	Holder, Release Cable
12		2	Washer
13		2	Nut
14	00198-5041	1	Enclosure, Battery Compartment
15	00198-1048	1	
16	2200-0166	2	Screw, Machine
17	00198-5053	1	Shield
18	00198-1039	1	Plate
19	00198-1024	1	Cover, Battery Compartment Outside
20	00198-5052	1	Spacer
21	16400-3025	1	Spring
22	2200-0069	2	Screw, Machine
23	2200-0166	2	Screw, Machine
24	00198-1002	1	Base, Camera
25	00198-1050		
26	Deleted	1	Gasket, Foam Rubber (no longer used)
27	00198-3029	1	Boss
28	2580-0004	2	Nut (#8-32)
29	00198-5040	2	Spacer, Guide
30	0510-0083	1	E-Ring
31	00198-5036	1	Arm

Figure 6-4. Camera Base Assembly (Sheet 1 of 3)

INDEX NO.	PART NUMBER	TQ	DESCRIPTION
32	00198-3038	1	Boss
33	00198-3037	1	Boss
34	00198-5035	1	Arm
35	2200-0165	2	Screw, Machine (#4-40)
36	0510-0045	2	Retainer
37	00198-5046	2	Cam
38	00198-1023	1	Bracket, Cam Lock
39	00198-3022	1	Shaft, Mounting Lock
40	00198-1022	1	Clamp, Lower Mounting
41	2390-0009	2	Screw, Machine (#6-32)
42		2	Washer
43	2550-0005	2	Screw, Machine (#8-32)
44	2200-0166	5	Screw, Machine (#4-40)
45	0370-0279	1	Lever Assembly, Mounting Lock Control
46	1000-0118	1	Cable Assembly, Release
47	00198-5044	1	Spacer
48	00198-5034	1	Socket, Release Cable
49	2210-0002	1	Screw, Machine (#4-40)
50	0370-0280	1	Knob Assembly, Focus Control
51		4	Screw, Set

Figure 6-4. Camera Base Assembly (Sheet 2 of 3)



INDEX NO.	PART NUMBER	TQ	DESCRIPTION
1	1251-0202	2	Receptacle, Shutter Sync Jack
2	00198-1000	1	Mask, Control Panel
3	00198-1042	1	Panel, Control
4		2	Nut
5		2	Terminal
6		2	Bushing
7	00198-1025	2	Bracket
8	00198-3047	2	Bushing
9	00198-3026	2	Shaft, Control
10	00198-5031	2	Gear, Drive
11	1480-0003	2	Pin, Stop
12	2100-1187	1	Resistor, Variable (RA25YN20RB, 20K ohm)
13	00198-5026	1	Holder, Shutter Set Lever
14	00198-5025	1	Lever, Shutter Set
15	00198-3025	1	Shaft, Shutter Set Lever
16	3050-0067	1	Washer, Flat
17	2190-0016	2	Washer
18	2260-0002	2	Nut
19	2190-0030	2	Washer, Lock
20	3101-0259	1	Switch, Graticule Slide (SL-23)
21	00198-5051	1	Mask, Graticule Switch
22	2200-0166	2	Screw, Machine
23	2200-0166	2	Screw, Machine
24	2950-0001	1	Nut
25		6	Screw, Set
26	0370-0133	3	Knob, Control
27	2950-0001	2	Nut
28	2190-0016	2	Washer

Figure 6-5. Camera Control Panel Assembly (Sheet 1 of 2)

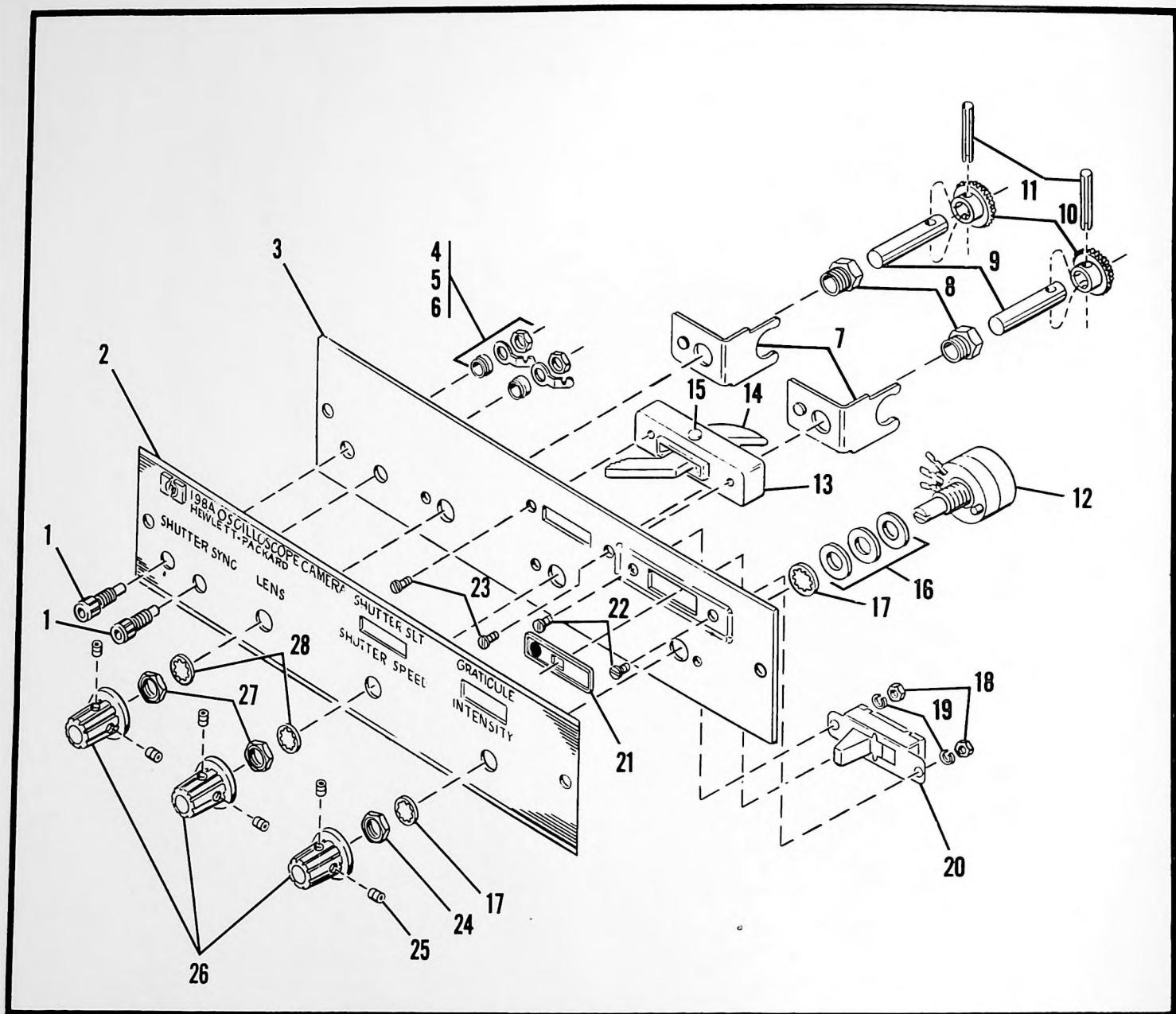


Figure 6-5. Camera Control Panel Assembly (Sheet 2 of 2)

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. MANUAL CHANGES.

7-2. This manual applies directly to the Model 198A Oscilloscope Camera with serial numbers prefixed with the prefix number on the title page. The following paragraphs give an explanation of how to adapt this manual to modified instruments. Technical corrections to this manual (if any) are listed under Errata on a separate Manual Changes sheet supplied with this manual.

7-3. As modifications are made to the Model 198A, the later models may have serial prefix numbers different from that listed on the manual title page. The manuals supplied with the later models will contain a Manual Changes sheet having all necessary updating data included. If the serial prefix number of a camera is different than that appearing on the title page of this manual, and a Manual Changes sheet was not included, contact the local Hewlett-Packard Sales/Service Office.

Note

There are no models earlier than listed on the title page.

7-4. OPTIONS.

7-5. Options for an HP instrument are standard modifications installed at the factory. Option 001: 1:0.7 object-to-image ratio allows entire HP 5 inch round CRT to be photographed.

7-6. SPECIAL INSTRUMENTS.

7-7. Special instruments are standard HP instruments modified at the factory in accordance with customer specifications and identified by an identification (ID) plate adjacent to the serial number ID plate. A separate insert sheet is included with the manual for each special instrument which has been modified in a way that could affect the replaceable parts list. Revise manual in accordance with the insert sheet for proper instrument coverage. If insert sheet is missing, contact the local HP Sales/Service Office. Ensure a complete description of the instrument is given, including the eight-digit serial number and specification number.

SECTION VIII

TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains a troubleshooting procedure for locating electrical, or mechanical trouble in the operation of the Model 198A. Component location photographs and a schematic are also included.

8-3. SCHEMATIC.

8-4. Due to simplicity of the electrical system of the Model 198A, the schematic is easy to follow for troubleshooting. The schematic shows the function of the electrical system. Symbols and abbreviations are listed in a legend located on the schematic. (See Figure 8-1.)

8-5. COMPONENT IDENTIFICATION.

8-6. Location of the components are identified in photos. (See Figure 8-2.) Some components located inside the chassis of the camera cannot be shown be-

cause of their location, but can be located by referring to the illustrated parts breakdown in Section VI, Figure 6-1.

8-7. TROUBLESHOOTING.

8-8. Troubleshooting the Model 198A consists of conducting a visual inspection and a mechanical checkout. If it is determined that the trouble lies in the electrical system, an electrical checkout should be performed.

8-9. Figure 8-2 is used in helping to locate components. However, some components within the chassis may not be shown. Referring to Figure 6-1 will be helpful in locating a part. Figure 8-1 shows the electrical circuitry. It can be used in checking out the electrical portion of the system.

8-10. VISUAL INSPECTION.

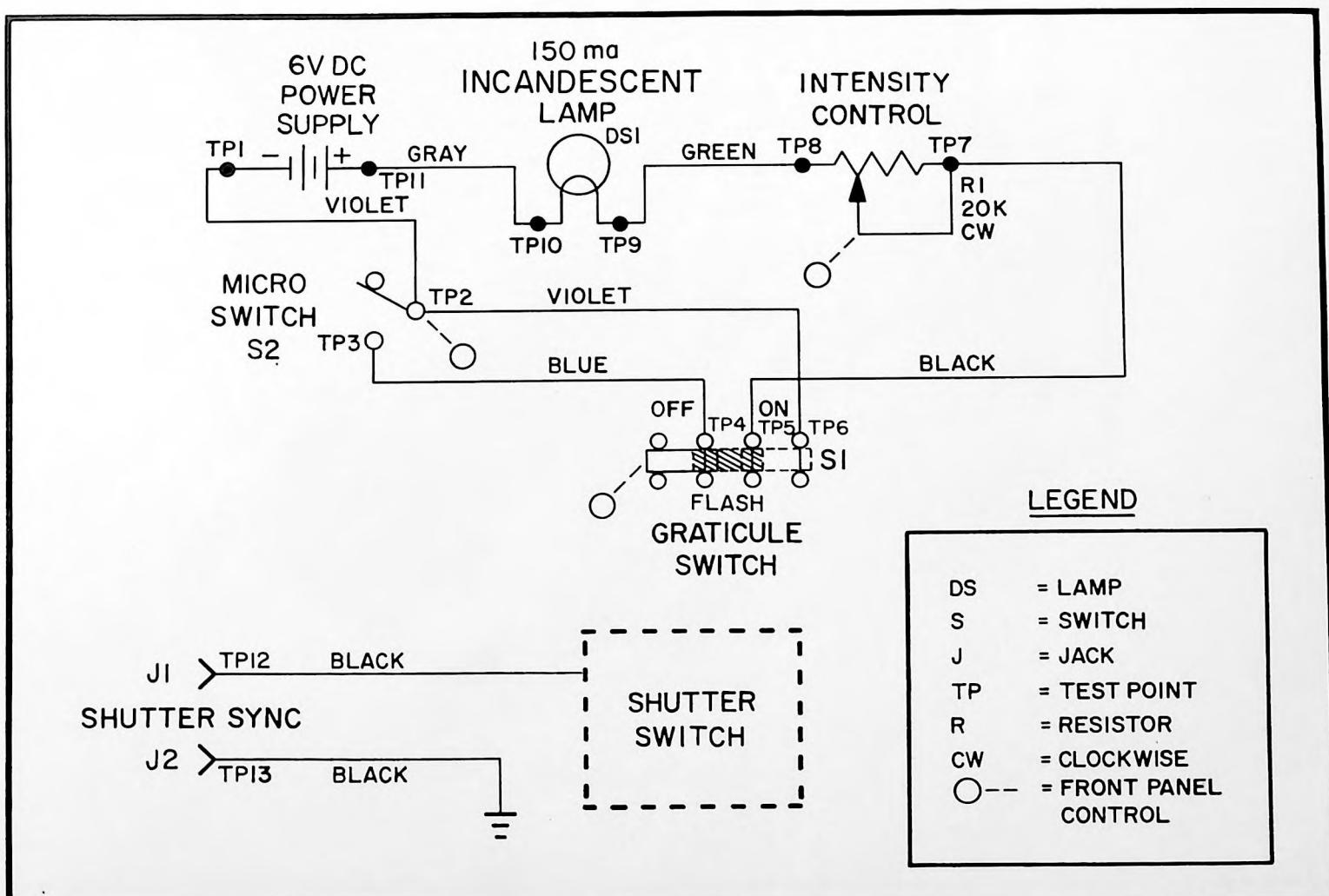
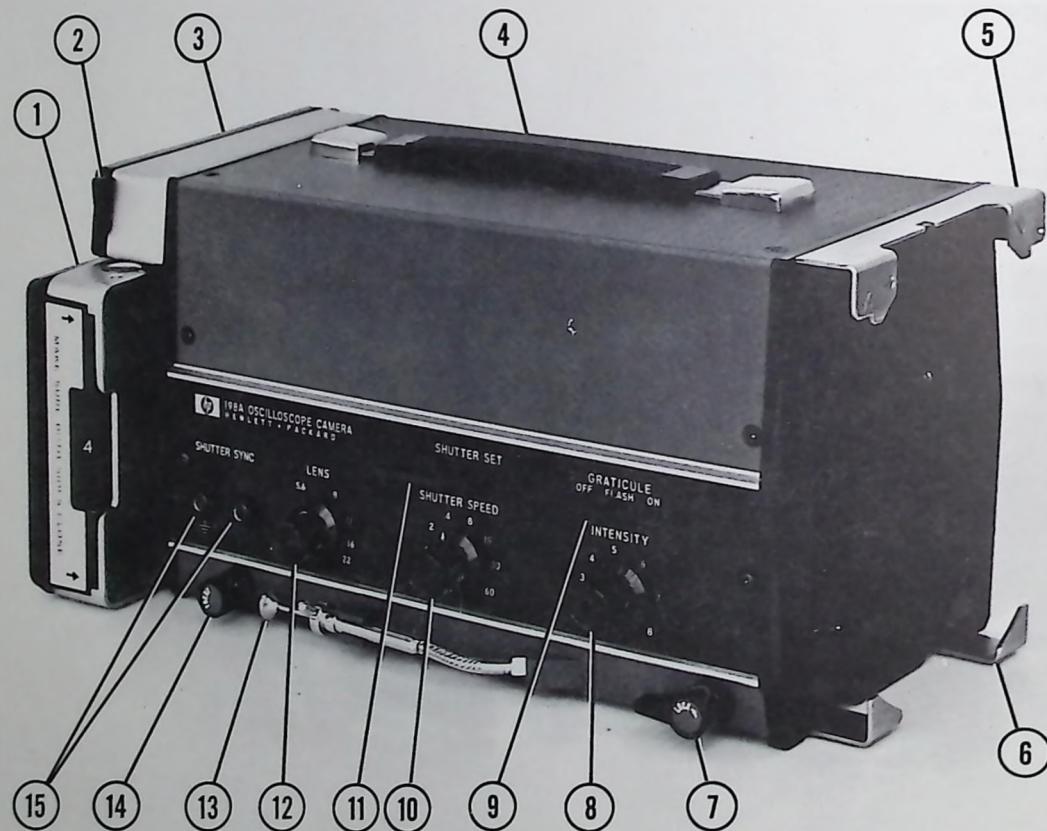


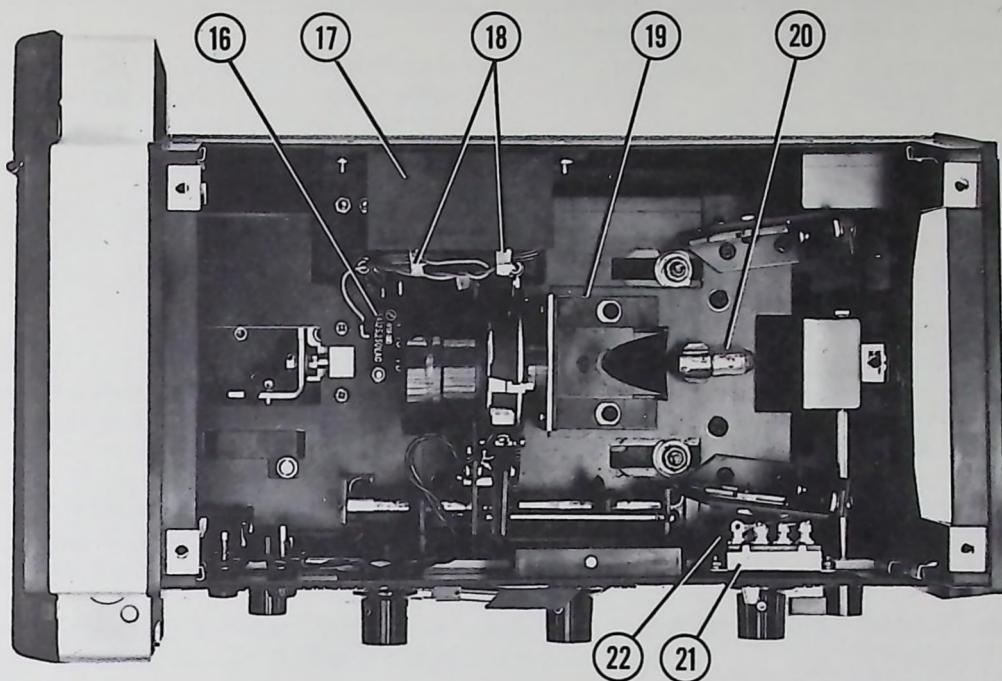
Figure 8-1. Camera Circuit Schematic

1. Camera Back	13. Shutter Release
2. Viewer Door Lever	14. Focus Control
3. Viewer	15. Shutter Sync Jack (Receptacle)
4. Camera Top Cover	16. Microswitch (Flash)
5. Upper Mounting Clamp	17. Power Supply Battery Compartment
6. Lower Mounting Clamp	18. Power Supply Terminals
7. Mounting Lock Lever	19. Lamp Cover
8. Intensity Control	20. Spare Lamp
9. Graticule Switch Control	21. Graticule Switch
10. Shutter Speed Control	22. Intensity Control (potentiometer)(Var. Res. 20K)
11. Shutter Set Lever	23. Battery Compartment Cover
12. Lens Control	24. Camera Back Door Latch

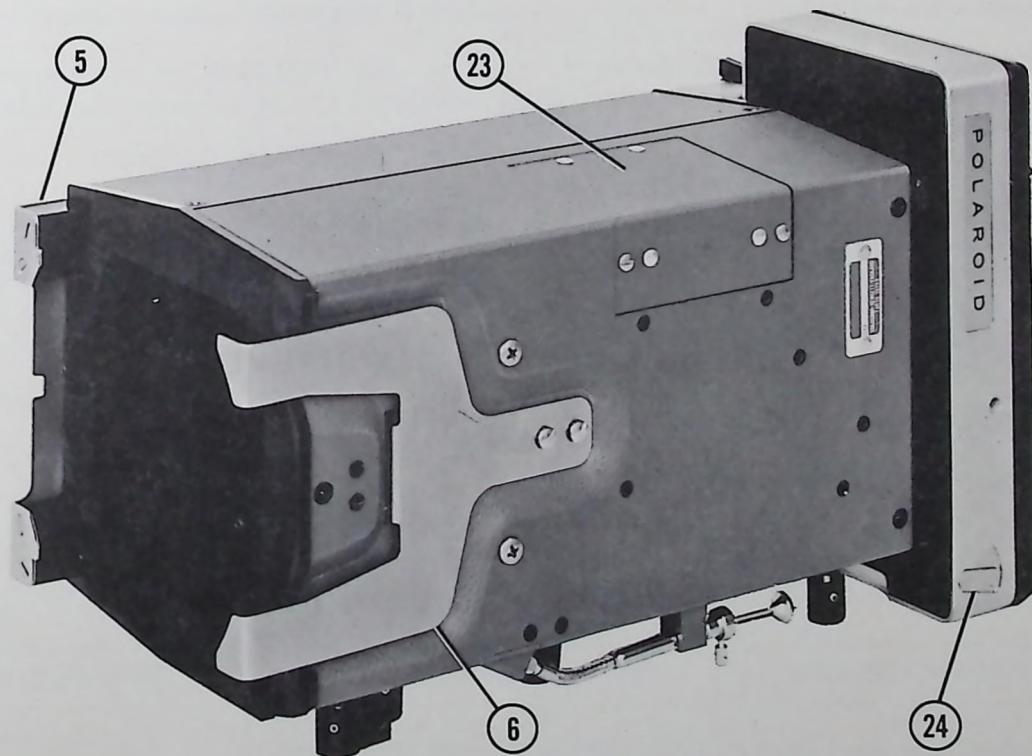


Right Side View

Figure 8-2. Component Locations (Sheet 1 of 2)



View Looking Down, Top Cover and
Shroud Removed



Camera Bottom View

Figure 8-2. Component Locations (Sheet 2 of 2)

8-11. Remove the camera top cover and visually inspect for loose or broken wires, defective lamp, loose or broken parts, and dents which could cause moveable parts to bind. If any of these are found, refer to Section V, Maintenance, and Section VI, Replaceable Parts.

8-12. MECHANICAL CHECKOUT.

8-13. The purpose of performing the mechanical checkout is to verify that all mechanical controls and moving parts operate according to the Model 198A specifications. If during checkout a malfunction occurs, determine where the fault lies and refer to Section V, Maintenance and Section VI, Replaceable Parts.

8-14. Perform mechanical checkout in accordance with the following steps: (See Figure 8-2 for component location.)

- a. Remove camera top cover (4) to observe moving parts during checkout.
- b. Remove film pack from camera back (if applicable).
- c. Rotate FOCUS control (14) fully clockwise. Then rotate fully counterclockwise and check carriage assembly for ease of travel. After check, position carriage midway.
- d. Open camera back (1) door.
- e. Push SHUTTER SET lever (11) fully forward. Then release it.
- f. Set LENS control (12) to position 3.5.
- g. Set SHUTTER SPEED control (10) to position 1.
- h. Observing lens and shutter from rear of camera (door open), press shutter release (13) and verify shutter opens and then closes in approximately one second.
- i. Set SHUTTER SPEED control (10) to position B.
- j. Push SHUTTER SET lever (11) fully forward. Then release it.

k. Observing lens and shutter from rear of camera, press shutter release (13) and hold. Verify shutter opens. Release shutter release and verify shutter closes.

l. Rotate LOCK lever (7) to vertical position and verify lower mounting clamp moves upward. Reposition LOCK lever counterclockwise to horizontal position.

m. Rotate LENS control (12) fully clockwise, then fully counterclockwise. Verify ease of operation and index pointer on knob is in calibration with positions on control panel.

n. Rotate SHUTTER SPEED control fully clockwise, and then fully counterclockwise. Verify ease of operation and index pointer on knob is in calibration with positions on control panel.

o. Set GRATICULE switch control (9) to ON position and rotate INTENSITY control (8) to position 8. Verify lamp is lighted to full brightness.

p. Slowly rotate INTENSITY control (8) counterclockwise and verify brightness of lamp dims.

q. Set GRATICULE switch control (9) to FLASH position and INTENSITY control (8) to position 8. Verify lamp not lighted.

r. Press shutter release (13) and verify lamp lights to full brightness. Then release shutter release.

s. Set GRATICULE switch control (9) to OFF position.

8-15. ELECTRICAL CHECKOUT.

8-16. The electrical checkout is performed if lamp fails to light with GRATICULE switch in either FLASH or ON position or SHUTTER SYNC fails to operate. Proceed with isolation checkout in accordance with Table 8-1 and Figure 8-1.



When performing point to point continuity check, ensure batteries are removed from battery compartment.

Table 8-1. Electrical Trouble Analysis (Sheet 1 of 3)

STEP	ISOLATION PROCEDURE	RESULT	CORRECTIVE ACTION
A	Lamp does not light when GRATICULE switch is positioned to ON.		
1	Replace power supply batteries.	<ul style="list-style-type: none"> a. Lamp lights. b. Lamp does not light 	<ul style="list-style-type: none"> a. Trouble corrected. b. Proceed to step 2.
2	Replace lamp.	<ul style="list-style-type: none"> a. Lamp lights. b. Lamp does not light. 	<ul style="list-style-type: none"> a. Trouble corrected. b. Proceed to step 3.

Table 8-1. Electrical Trouble Analysis (Sheet 2 of 3)

STEP	ISOLATION PROCEDURE	RESULT	CORRECTIVE ACTION
3	Check continuity between TP5 and TP6 (with batteries removed).	a. No continuity. Indicates defective switch S1. b. Continuity obtained.	a. Replace switch S1. Trouble corrected. b. Proceed to step 4.
4	Check continuity between TP5 and TP11.	a. No continuity. b. Continuity obtained.	a. Proceed to step 5. b. Proceed to step 9.
5	Check continuity between TP5 and TP7.	a. No continuity. Indicates loose or broken wire. b. Continuity obtained.	a. Repair or replace wire. Trouble corrected. b. Proceed to step 6.
6	Check continuity between TP7 and TP8, with INTENSITY control rotated fully clockwise.	a. No continuity. Indicates R1 defective. b. Continuity obtained.	a. Replace R1. Trouble corrected. b. Proceed to step 7.
7	Check continuity between TP8 and TP9.	a. No continuity. Indicates loose or broken wire. b. Continuity obtained.	a. Repair or replace wire. Trouble corrected. b. Proceed to step 8.
8	Check continuity between TP10 and TP11.	No continuity. Indicates loose or broken wire.	Repair or replace wire. Trouble corrected.
9	Check continuity between TP1 and TP6.	No continuity.	Proceed to step 10.
10	Check continuity between TP2 and TP6.	a. No continuity. Indicates loose or broken wire. b. Continuity obtained.	a. Repair or replace wire. Trouble corrected. b. Proceed to step 11.
11	Check continuity between TP1 and TP2.	No continuity. Indicates loose or broken wire.	Repair or replace wire. Trouble corrected.
B	Lamp does not light when GRATICULE switch is positioned to FLASH.		
1	Set GRATICULE switch to ON position. Lamp should light.	a. Lamp does not light. b. Lamp lights.	a. Perform trouble analysis A, step 1 thru step 11. Trouble corrected. b. Proceed to step 2.
2	Reposition GRATICULE switch to FLASH. Check continuity between TP4 and TP5. (With batteries removed.)	a. No continuity. Indicates defective switch. b. Continuity obtained.	a. Replace switch S1. Trouble corrected. b. Proceed to step 3.
3	Check continuity between TP3 and TP4.	a. No continuity. Indicates loose or broken wire. b. Continuity obtained.	a. Repair or replace wire. Trouble corrected. b. Proceed to step 4.
4	Connect ohmmeter leads to TP2 and TP3. Press shutter release and hold. Check for continuity, then release.	No continuity. Indicates defective microswitch S2, or shutter release actuator lever does not actuate switch.	Check out mechanical operation of microswitch or replace switch S2. Trouble corrected.

Table 8-1. Electrical Trouble Analysis (Sheet 3 of 3)

STEP	ISOLATION PROCEDURE	RESULT	CORRECTIVE ACTION
C	SHUTTER SYNC fails to operate.		
1	Connect ohmmeter to TP12 and TP13 of J1 and J2. Check for continuity.	<p>a. Continuity obtained. Indicates defective shutter sync switch.</p> <p>b. No continuity.</p>	<p>a. Operate shutter several times and recheck for continuity. If results are same, replace shutter assembly. Trouble corrected.</p> <p>b. Proceed to step 2.</p>
2	Set SHUTTER SPEED control to position B, and push SHUTTER SET lever fully forward. With SHUTTER SYNC jacks still connected to ohmmeter, press shutter release and hold. Check for continuity.	No continuity. Indicates defective shutter switch.	Replace shutter assembly. Trouble corrected.

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